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ABSTRACT

This guide contains a course outline for a tractor mechanic course. The outline is organized by 15 duties: performing general skills and maintaining and servicing storage battery, ignition circuit, the cooling system, the charging circuit, the starting circuit, gasoline fuel system, diesel fuel system, basic engine, lubrication system, clutches, hydraulics, powertrain, differentials, and final drive. Each duty is further divided into job-relevant tasks. These components are provided for each task: standard of performance of task, source of standard, conditions for performance of task, enabling objectives, resources, teaching activities, a criterion-referenced measure (practical application and method of evaluating practical applications), and a performance checklist for evaluation. Appendixes include definitions of terms; a cross-reference of duties, tasks, and performance objectives; a tool and equipment list; and a bibliography. (YLB)

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V-TECS GUIDE
FOR
TRACTOR MECHANIC

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The Tractor Mechanics V-TECS Guide was developed from the Tractor Mechanics V-TECS Catalog by a committee of Agricultural Mechanics instructors in South Carolina. These instructors are to be commended for their expertise in the field and for their ability to complete the tedious work required in developing this V-TECS Guide. The writers are: Kellon Hall (Marlboro Vocational School), Olin Coskrey (Darlington Career Center), Jakie Lewis (Dillon County Area Vocational Center), and John Weathers (Sumter County Career Center).

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Upon completion of the writing of the Tractor Mechanics V-TECS Guide, educators were selected to field review the material for validity and reliability. These educators are to be commended for their thoroughness in providing expertise in modifying and approving this guide for classroom use. The field reviewers were:

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INTRODUCTION

V-TECS guides are an extension or continuation of the V-TECS catalogs. While the V-TECS catalog is a composition of duties, tasks, performance objectives, and performance guides, it deals only with the psychomotor aspect of an occupation. It is a blueprint of an occupation. It deals only with the identification of the hands-on aspect of the occupation. It does not take into consideration such things as the background information surrounding a task, how to make inferences, generalizations and decisions from a body of knowledge, nor does it deal with attitudes, job seeking skills, safety or energy conservation practices. V-TECS guides take these aspects of teaching and learning into consideration.

Experience has shown that the art of learning can also be taught while teaching subject matter. People need to learn how to learn. V-TECS guides take into consideration how students learn and are an efficient way for instructors to assist them to learn.

V-TECS guides are centered around all three domains of learning: psychomotor, cognitive, and affective. The following is a brief explanation of each.

Psychomotor

Any manipulative skill such as tightening a nut, replacing a hubcap, sharpening a pencil, machining a key slot in a steel shaft, or replacing a SCR in a solid state control panel are examples of manipulative or psychomotor skills. Tasks such as these are identified in V-TECS catalogs. V-TECS catalogs also group tasks by duties and objectives. Each performance objective has a performance standard which must be met to prove student proficiency in the manipulative aspect of the task. The V-TECS catalog, however, does not include any suggestions on how to learn to do these tasks.

V-TECS guides are developed around psychomotor tasks which are worker oriented.

Cognitive

To perform psychomotor tasks, students must think. To tighten a nut they must know which way to turn it and when to stop turning it so that they won't strip the threads or shear the bolt off. If replacing a hubcap, there is a certain technique that may vary from one car to another. For example, start the hubcap by placing the cap in a tilted position and tapping it all the way around until it is properly seated. On a different model, it may be necessary to position the hubcap and snap it all at once. At any rate, students must think about what is being done. This is cognition or a mental activity. Cognition is what goes on in the mind about any job being done. V-TECS guides provide both the collateral knowledge and the impetus to apply cognition to psychomotor tasks.

Students gain cognition through both real and vicarious experiences. They may read, view tapes, memorize or practice a process or procedure until they are certain of it. To test their knowledge, students may be required to decide the proper procedure, method or sequence for performance. This is decision making or cognitive activity at its highest.

Cognition, then, is that process by which information is stored and used. That voice that warns one of potential dangers is cognition. Anything that goes on in the mind is cognition. Students may become the best workers in their job; but, if they fail to think a process through and apply their experience, they may become just one more statistic. It is cognition that tells them to lock and tag out the power supply to an electrical apparatus before starting to repair it. However, cognition does not apply only to safety. Good cognition or thinking can help employees do a job better and quicker. V-TECS guides provide for the cognitive aspects of learning.

Affective

Curriculum writers, supervisors, and instructors often fail to assist students in acquiring a positive attitude toward themselves, their jobs, their school, or their fellow students. V-TECS guides seek to provide assistance to the instructor in achieving this. It is difficult for the instructor to identify bits and pieces of desirable behavior for every unit and often harder yet to teach them. In this area, students might be judged as to how well they clean their work area, or whether they show up to do the job on time, or whether they must be told several times to do something. Potential employers are interested in student attitude because persons angry at themselves or uncertain of themselves are often poor workers.

A student's ability to succeed on the first job and every job thereafter depends largely on attitude. If, for example, students have the attitude of "let someone else do it," they could be in trouble. Students using V-TECS guides will have activities dealing with how to get along with other students, supervisors, or staff member in both large and small groups.

USE OF V-TECS GUIDE

The guide is designed to provide job-relevant tasks, performance objectives, performance guides, resources, learning activities, evaluation standards, and achievement testing in selected occupations.

A V-TECS guide is designed to be used with any teaching methods you may choose. If a lecture/demonstration method is best for you, you will find sufficient help to meet your needs. If you prefer to use discussions or other methods that require student participation, you will find ample help. Regardless of which method is successful for you, a V-TECS guide can save preparation time and offer innovative methods and procedures. For example, students may work either alone or in teams while in class and learn skills in direct relation to what is actually done on the job. This work also takes into consideration student attitudes, thinking skills, and mathematical reading skills.

The use of small groups in teaching can be helpful in two ways: (1) many students may feel inadequate due to their lack of background information in mechanical things; and (2) some students may feel that they are physically incompetent or lack the necessary background experiences. A successful program (course) can provide students with a sense of security by reinforcing positive attitudes while improving skill and knowledge of the subject. By allowing students to interact on a personal level, this task/learner-centered approach can achieve this. As students gain confidence and discover that they are an essential part of a team engaged in the learning-teaching process, their confidence increases. Too, the student in this setting can learn to work without direct supervision. In addition, use of the small-group method permits the instructor to vary instructional routines away from lecture or other full-class methods to activities for single students, pairs of students or any number so desired.

You will find suggestions for specific classroom activities. These activities are not meant to restrict you or your students, but only to suggest a variety of learning activities for each task statement. Please do not feel that you must take your students through all the activities.

PERFORMING GENERAL SKILLS

DUTY: PERFORMING GENERAL SKILLS

PERFORMANCE OBJECTIVE V-TECS 1

TASK: Adjust wheel bearings.

STANDARD OF PERFORMANCE OF TASK:
Manually adjust the wheel bearings on the assigned tractor. The adjusted wheel should roll freely with no loose motion.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a basic mechanic's tool set, jack, and safety stand, manually adjust the wheel bearings on an assigned tractor.

ENABLING OBJECTIVE(S):

1. Use of shop jack.
2. Identify and use safety procedures in the use of a jack.

RESOURCES:

1. Shop manual for equipment.
2. AAVIM, **Tractor Maintenance Principles and Procedures**, pp. 115-119.

TEACHING ACTIVITIES:

1. Discuss reasons for proper wheel bearing adjustment.
2. Describe how wheel bearings are adjusted.
3. Demonstrate how wheel bearings are adjusted.
4. Have students describe how wheel bearings are adjusted.
5. Have students perform wheel bearing adjustment.

CRITERION REFERENCED MEASURE:

Practical Application:
Given necessary tools and equipment manually adjust the wheel bearings.

Method of Evaluating Practical Application:
Using the checklist for PO #01, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 1 EVALUATION

PERFORMANCE TEST FOR ADJUSTING WHEEL BEARINGS

Student's Name **Date**

DIRECTIONS TO STUDENT: Manually adjust wheel bearings using the mechanics tool set, jack and safety stand. All items on checklist must be completed and the adjusted wheel bearings must allow wheel to rotate freely with no loose lateral motions.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Raised tractor with jack and placed safety stands under axle.	______	______
2.	Removed dust cover and cotter pin.	______	______
3.	Rotated wheel.	______	______
4.	Tightened nut properly and replaced cotter pin.	______	______
5.	Checked wheel for free rotation and side to side motion.	______	______
6.	Replaced dust cover.	______	______
7.	Raised tractor with jack, removed safety stand and lowered tractor.	______	______

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

DUTY: PERFORMING GENERAL SKILLS

PERFORMANCE OBJECTIVE V-TECS 2

TASK: Adjust wheel bearings.

STANDARD OF PERFORMANCE OF TASK:
Using the torque wrench, adjust the wheel bearings to specifications on the assigned tractor.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a low measuring (inch-pound) torque wrench, other basic tools, jack, and safety stand, adjust wheel bearings on the assigned tractor to the torque specified in the repair manual.

ENABLING OBJECTIVE(S):

1. Use of shop jack.
2. Knowledge of safety procedures in the use of a jack.
3. Ability to read.

RESOURCES:

1. Shop manual for equipment

TEACHING ACTIVITIES:

1. Explain reasons for proper wheel bearings adjustment.
2. Discuss how wheel bearings are adjusted with a torque wrench.
3. Demonstrate how wheel bearings are adjusted with a torque wrench.
4. Have students explain how wheel bearings are adjusted with a torque wrench.
5. Have student perform wheel bearings adjustment using a torque wrench.

CRITERION REFERENCED MEASURE:

Practical Application:
Given necessary tools and equipment, adjust the wheel bearings using a torque wrench.

Method of Evaluating Practical Application:
Using checklist for PO #2, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 2 EVALUATION

PERFORMANCE TEST FOR ADJUSTING WHEEL BEARINGS

Student's Name **Date**

DIRECTIONS TO STUDENT: Adjust wheel bearings using torque wrench. Using low measuring torque wrench (inch-pounds), other basic tools, jack and safety stands. All items on checklist must be completed and torque on adjusted wheel bearing must be the same as manufacturer's specification.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1.	Raised tractor with jack and placed safety stand under axle.		
2.	Cleaned and removed dust cover and cotter pin.		
3.	Checked torque specifications.		
4.	Tightened nut to correct specifications with correct socket.		
5.	Installed new cotter pin and replaced dust cover.		
6.	Jacked up tractor, removed safety stand and lowered tractor with jack.		

APPROVED Yes ___ No ___

Evaluator's Signature Date

DUTY: PERFORMING GENERAL SKILLS

PERFORMANCE OBJECTIVE V-TECS 3

TASK: Check tires for pressure, wear, and defects.

STANDARD OF PERFORMANCE OF TASK:
Check tires on the designated tractor for proper inflation and identify defects and wear. Tire pressure will be 100% accurate as indicated in the manufacturer's specifications and all defects identified.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a tractor with worn and damaged tires, jack, and tire gauge, check the tires for proper inflation and visually examine tires for wear and defects.

ENABLING OBJECTIVE(S):

1. Use shop jack.
2. Knowledge of safety procedures in the use of a jack
3. Ability to read.

RESOURCES:

1. AAVIM, **Tractor Maintenance Principles and Procedures**, pp. 40-43.
2. Tire Manufacturer's Manual.

TEACHING ACTIVITIES:

1. Explain reasons for proper tire maintenance.
2. Describe cause of defects and wear.
3. Show proper way to check tire pressure.
4. Have student to describe how to check tires for pressure, wear, and defects.
5. Have student perform task of checking tire pressure, wear, and defects.

CRITERION REFERENCED MEASURE:

Practical Application:
Given necessary tools and equipment, check tires for pressure, wear and defects.

Method of Evaluating Practical Application:
Use checklist for PO #3 all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 3 EVALUATION

PERFORMANCE TEST FOR CHECKING TIRES FOR PRESSURE WEAR AND DEFECTS

Student's Name **Date**

DIRECTIONS TO STUDENT: Check tires for pressure, wear and defects using jack, safety stands and tire gauge. All steps on checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Raised tractor with jack and placed safety stand under axle.		
2.	Placed valve stem at top of rotation and checked pressure with gauge.		
3.	Inflated to recommended PSI.		
4.	Visually inspected tires and identified any wear and defects.		
5.	Raised tractor with jack, removed jack stand and lowered tractor with jack.		

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

DUTY: PERFORMING GENERAL SKILLS

PERFORMANCE OBJECTIVE V-TECS 5

TASK: Inspect new tractor parts for shipping damage.

STANDARD OF PERFORMANCE OF TASK:
Open a box of tractor parts and perform visual inspection for damage to the contents. All accepted parts should show no damage.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given an unopened box of tractor parts, open the box and inspect contents for damage.

ENABLING OBJECTIVE(S):

1. Identify and read packing list.
2. Use of hand tools.

RESOURCES:

1. None

TEACHING ACTIVITIES:

1. Explain reasons for inspecting new tractor parts.
2. Describe how damage in shipping can occur.
3. Demonstrate how part should be inspected.
4. Have students describe how to inspect new parts for damage.
5. Have students perform task of inspecting new tractor parts for shipping damage.

CRITERION REFERENCED MEASURE:

Practical Application:
Given an unopened box of tractor parts, open the box and inspect contents for damage.

Method of Evaluating Practical Application:
Using checklist for PO #5, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 5 EVALUATION

PERFORMANCE TEST FOR INSPECTING NEW TRACTOR PART FOR SHIPPING DAMAGE

Student's Name **Date**

DIRECTIONS TO STUDENT: Open the parts box and inspect contents for damage.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1.	Opened package using proper tools.	________	________
2.	Removed and read packing list.	________	________
3.	Checked that all parts listed on the packing slip were there.	________	________
4.	Inspected each part for damage.	________	________
5.	Put usable parts in appropriate storage or to use.	________	________
6.	Returned damaged part to supplier.	________	________

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

DUTY: PERFORMING GENERAL SKILLS

PERFORMANCE OBJECTIVE V-TECS 6

TASK: Clean tractor with a steam cleaner. (Prepare steam cleaner for use).

STANDARD OF PERFORMANCE OF TASK:
In the laboratory area, prepare the steam cleaner for use. The preparation must include acceptable completion of all of the steps on the instructor's checklist.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a steam cleaner, power source, soap solution and water supply, prepare the steam cleaner for use.

ENABLING OBJECTIVE(S):
1. Ability to read.

RESOURCES:
1. **Agriculture Shop Safety Student Manual**, p. 49.

TEACHING ACTIVITIES:
1. Discuss reasons for preparing steam cleaner for use.
2. List steps in preparing a steam cleaner for use.
3. Prepare a steam cleaner for use.
4. Review steps in preparing steam cleaner for use.
5. Have student prepare a steam cleaner for use.

CRITERION REFERENCED MEASURE:

Practical Application:
Given a steam cleaner, power source, fuel and water supply, prepare a steam cleaner for use.

Method of Evaluating Practical Application:
Using Checklist for PO #6, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 6 EVALUATION

PERFORMANCE TEST FOR CLEANING TRACTOR WITH STEAM CLEANER

Student's Name **Date**

DIRECTIONS TO STUDENT: Prepare the steam cleaner for use. All steps in the performance guide must be completed in a satisfactory manner.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe the student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Visually inspected the machine.		
2.	Attached water hose and power cord.		
3.	Added soap (detergent)		
4.	Replaced drain plug if needed.		
4.	Checked fuel and filled if needed.		
6.	Turned on fuel and power sources.		
7.	Started pump.		
8.	Uncoiled hose.		
9.	Started burner when water ran from nozzle.		

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

DUTY: PERFORMING GENERAL SKILLS

PERFORMANCE OBJECTIVE V-TECS 7

TASK: Clean tractor with steam cleaner.

STANDARD OF PERFORMANCE OF TASK:
In a well ventilated area of the laboratory, clean a tractor with the steam cleaner. Upon inspection the tractor should show no signs of dirt, oil, or grease.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a dirty tractor and a steam cleaner prepared for use, clean the tractor.

ENABLING OBJECTIVE(S):

1. Ability to read.

RESOURCES:

1. Tractor Manufacturer's Manual.
2. Steam cleaner manual.

TEACHING ACTIVITIES:

1. Explain reasons for cleaning tractor.
2. Discuss the different ways to clean a tractor.
3. Show how a tractor can be cleaned with a steam cleaner.
4. Review steps in cleaning tractor with a steam cleaner.
5. Have student clean tractor using a steam cleaner.

CRITERION REFERENCED MEASURE:

Practical Application:
Given a dirty tractor and a steam cleaner prepared for use, clean the tractor.

Method of Evaluating Practical Application:
Using Checklist for PO #7, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 7 EVALUATION

PERFORMANCE TEST FOR CLEANING TRACTOR WITH STEAM CLEANER

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a dirty tractor and a steam cleaner prepared for use, clean the tractor. The tractor must show no sign of dirt, oil, or grease when completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Removed tractor hood, muffler, and air breather.	___	___
2.	Covered exhaust and intake openings.	___	___
3.	Applied degreaser to heavy grease and oil deposits.	___	___
4.	Secured protective clothing, gloves, and safety face shield.	___	___
5.	Held end of nozzle 8" to 10" from tractor.	___	___
6.	Moved nozzle in a back and forth motion parallel to tractor.	___	___
7.	Avoided steaming of areas such as starter, generator, etc.	___	___
8.	Continuously checked functioning of steam cleaner.	___	___
9.	Cleaned all areas of tractor, used soap for first application, finished. with steam only.	___	___

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

DUTY: PERFORMING GENERAL SKILLS

PERFORMANCE OBJECTIVE V-TECS 8

TASK: Clean tractor with steam cleaner. (Shut off steam cleaner).

STANDARD OF PERFORMANCE OF TASK:
Following the use of the steam cleaner, prepare the cleaner for shut down. The preparation must include completion of all the steps in the instructor's checklist.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
In the laboratory area, prepare and shut down the steam cleaner.

ENABLING OBJECTIVE(S):

1. None

RESOURCES:

1. **Agriculture Shop Safety Student Manual**, p. 49.

TEACHING ACTIVITIES:

1. Discuss safety procedures in shutting off steam cleaner.
2. Identify the steps in shutting off a steam cleaner.
3. Demonstrate how to shut off a steam cleaner.
4. Have student explain steps in shutting off steam cleaner.
5. Have students perform the task of shutting off steam cleaner.

CRITERION REFERENCED MEASURE:

Practical Application:
Given a steam cleaner that is running, prepare and shut down the steam cleaner.

Method of Evaluating Practical Application:
Using Checklist for P0 #8, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 8 EVALUATION

PERFORMANCE TEST FOR CLEANING TRACTOR WITH STEAM CLEANER

Student's Name **Date**

DIRECTIONS TO STUDENT: Prepare the steam cleaner for shut down following use.

DIRECTIONS TO EVALUATOR: Provided needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Shut off burner and soap solution.	__________	__________
2.	Allowed pump to run until water from nozzle is cold.	__________	__________
3.	Shut off pump and water supply.	__________	__________
4.	Disconnected water and power sources.	__________	__________
5.	Drained the machine.	__________	__________
6.	Cleaned and put away steam cleaner and cleaning materials.	__________	__________

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

DUTY: PERFORMING GENERAL SKILLS

PERFORMANCE OBJECTIVE V-TECS 9

TASK: Paint tractors. (Prepare tractor for painting).

STANDARD OF PERFORMANCE OF TASK:
Using necessary repair tools, needed repair parts, and paint materials, prepare a tractor for painting.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
In the paint area of the shop, prepare a tractor for painting.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Use of hand tools.

RESOURCES:

1. Paint gun manufacturer's manual.

TEACHING ACTIVITIES:

1. Explain the reasons for proper preparation for painting a tractor.
2. Discuss safety procedures used in preparation for painting.
3. Show proper way to prepare a tractor for painting.
4. Answer questions student has about proper painting preparation.
5. Have student prepare a tractor for painting.

CRITERION REFERENCED MEASURE:

Practical Application:
Given necessary repair tools, needed repair parts, and paint materials, prepare a tractor for painting.

Method of Evaluating Practical Application:
Using Checklist for PO #8, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 9 EVALUATION

PERFORMANCE TEST FOR PREPARING TRACTOR FOR PAINTING

Student's Name **Date**

DIRECTIONS TO STUDENT: Given necessary repair tools, needed repair parts, and paint materials, prepare a tractor for painting.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Hammered out dents, filled and smoothed body putty.	____	____
2.	Sanded rough areas; steam cleaned all areas to be painted.	____	____
3.	Masked areas not to be painted with masking tape.	____	____
4.	Primed bare spots.	____	____
5.	Made minor repairs.	____	____
6.	Bathed surface with demagnetizing solution.	____	____
7.	Set up tractor in paint room.	____	____

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

DUTY: PERFORMING GENERAL SKILLS

PERFORMANCE OBJECTIVE V-TECS 10

TASK: Paint tractors.

STANDARD OF PERFORMANCE OF TASK:
In the paint area of the shop, paint a tractor. The complete paint job should be smooth, glossy, and with only minor runs.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a tractor set-up in a paint room, gun, respirator, and compressed air source, paint the tractor.

ENABLING OBJECTIVE(S):

1. Use of hand tools.
2. Ability to read.

RESOURCES:

1. Manufacturer's manual for paint gun.

TEACHING ACTIVITIES:

1. Discuss safety procedures that are used when painting.
2. Explain the proper way to mix paint.
3. Review proper steps in painting a tractor.
4. Demonstrate the proper way to paint a tractor.
5. Have student paint a tractor.

CRITERION REFERENCED MEASURE:

Practical Application:
Given a tractor set-up in a paint room, gun, respirator, and compressed air source, paint the tractor. The completed paint job should be smooth, glossy, and with only minor runs.

Method of Evaluating Practical Application:
Using Checklist for PO #10, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 10 EVALUATION

PERFORMANCE TEST FOR PAINTING TRACTORS

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a tractor set-up in a paint room, gun, respirator, and compressed air source, paint the tractor. The completed paint job should be smooth, glossy, and with only minor runs.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1.	Checked room for proper temperature and humidity level.		
2.	Set-up paint gun.		
3.	Set air pressure.		
4.	Turned on exhaust system.		
5.	Checked paint thickness.		
6.	Filled gun reservoir through strainer.		
7.	Put on respirator.		
8.	Adjusted gun.		
9.	Painted tractor.		
10.	Cleaned gun.		
11.	Put away equipment.		

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

DUTY: PERFORMING GENERAL SKILLS

PERFORMANCE OBJECTIVE V-TECS 11

TASK: Repair brake assemblies.

STANDARD OF PERFORMANCE OF TASK:
Repair the brake assembly on the designated tractor. All parts will be clean, back in place and the brakes will be adjusted to specifications.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given rebuilt brake shoes, a service manual, jack, wheel blocks, solvents and rags, replacement parts, a mechanic's tool set and a brake tool set, repair a brake assembly.

ENABLING OBJECTIVE(S):

1. Knowledge of safety procedures in the use of a shop jack.
2. Ability to read.
3. Use of hand tools.

RESOURCES:

1. AAVIM, **Tractor Maintenance Principles and Procedures,** pp. 77-82.
2. Tractor manufacturer service manual.

TEACHING ACTIVITIES:

1. Explain the importance of proper brake repair.
2. Show student different types of brake assemblies.
3. Discuss different cause of defects and wear.
4. Describe the proper way to repair brake assemblies.
5. Demonstrate how to repair brake assembly.

CRITERION REFERENCE MEASURE:

Practical Application:
Given necessary tools and equipment and service manual. Repair the brake assembly on a designated tractor.

Method of Evaluating Practical Application:
Using Checklist for PO #11, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 11 EVALUATION

PERFORMANCE TEST FOR REPAIRING BRAKE ASSEMBLIES

Student's Name **Date**

DIRECTIONS TO STUDENT: Given rebuilt brake shoe, a service manual, and the necessary tools and equipment, repair the brake assembly on a designated tractor. All parts will be clean, back in place and the brakes will be adjusted to specifications.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1.	Blocked wheels.		
2.	Jacked up tractor and removed wheel.		
3.	Pulled off brake drum.		
4.	Removed shoe retainers.		
5.	Removed shoes.		
6.	Cleaned all parts and inspected for excessive wear.		
7.	Replaced shoes with rebuilt shoes.		
8.	Replaced all worn parts as necessary.		
9.	Reinstalled shoes and hardware.		
10.	Reinstalled drum.		
11.	Reinstalled wheel.		
12.	Adjusted brake shoes to manufacturer's specifications.		

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

DUTY: PERFORMING GENERAL SKILLS

PERFORMANCE OBJECTIVE V-TECS 12

TASK: Service air cleaner (oilbath).

STANDARD OF PERFORMANCE OF TASK:
Service the oil-type air cleaner on the tractor. The service must include acceptable completion of all steps on the instructor checklist.

SOURCE OF STANDARD:
Tractor Operation and Daily Care, American Association for Vocational Instructional Materials, 1970.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a tractor equipped with oil-type air cleaner, operator's manual, necessary tools and supplies, service an oil-type air cleaner.

ENABLING OBJECTIVE(S):

1. Use of hand tools.
2. Ability to read.

RESOURCES:

1. Tractor operator's manual.
2. **Fundaments of Operation - Engine,** 3rd ed., pp. 6-4 through 6-5.
3. **Modern Farm Power,** pp. 53-54.

TEACHING ACTIVITIES:

1. Explain reasons for servicing air cleaners.
2. Discuss how to service an oilbath air cleaner.
3. Demonstrate how to service an oilbath air cleaner.
4. Review steps in servicing an oilbath air cleaner.
5. Have student to perform the task of servicing an oilbath air cleaner.

CRITERION REFERENCED MEASURE:

Practical Application:
Given a tractor equipped with oilbath air cleaner, operator's manual necessary tools and supplies, service an oilbath air cleaner.

Method of Evaluating Practical Application:
Using the Checklist for PO #12, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 12 EVALUATION

PERFORMANCE TEST FOR SERVICING AIR CLEANER (OILBATH)

Student's Name **Date**

DIRECTIONS TO STUDENT: Service an oilbath air cleaner, all items on checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1.	Loosened and removed oil cup from filter.	________	________
2.	Checked depth of sediment deposit in outer chamber.	________	________
3.	Cleaned oil cup.	________	________
4.	Checked and cleaned air intake pipe.	________	________
5.	Refilled oil cup.	________	________
6.	Replaced oil cup and tightened clamp.	________	________
7.	Checked air duct between a cleaner and carburetor for holes or loose connections; tightened or replaced as needed.	________	________
8.	Removed trash from inlet screen or precleaner.	________	________

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

DUTY: PERFORMING GENERAL SKILLS

PERFORMANCE OBJECTIVE V-TECS 13

TASK: Service drive shafts.

STANDARD OF PERFORMANCE OF TASK:
Service the drive shafts on the designated tractor. All parts will be clean and lubricated with the recommended lubricant, and there will be no damage to any parts.

SOURCE OF STANDARD:
Fundamentals of Service - Power Trains, Deere and Company, Moline, ILL., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Using the designated tractor, the manufacturer's service manual, shop rags, lubricants, and the necessary tools, service the drive shafts.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Use of handtools.

RESOURCES:

1. **Fundamentals of Service - Power Trains,** pp. 9-4.
2. Tractor service manual.

TEACHING ACTIVITIES:

1. Describe the basic types of drive shafts.
2. Discuss reasons for drive shaft service.
3. Show illustrations of how to service a drive shaft.
4. Have student identify different types of drive shafts, and explain how to service them.
5. Have student to perform task of drive shaft service.

CRITERION REFERENCED MEASURE:

Practical Application:
Given the necessary tools and equipment, service drive shafts.

Method of Evaluating Practical Application:
Using the Checklist for PO #13, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 13 EVALUATION

PERFORMANCE TEST FOR SERVICING DRIVE SHAFTS

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a designated tractor, manufacturer's service manual, shop rags, lubricants, and necessary tools, service the drive shafts. The service must include completion of all steps on the instructor's checklist.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Shut off engine and disengaged all power.		
2.	Removed all parts necessary to reach drive shaft.		
3.	Cleaned off visible dirt.		
4.	Lubricated telescoping drive shafts.		
5.	Checked PTO drive shaft.		
6.	Inspected and lubricated the bearings.		
7.	Inspected and lubricated the universal joints.		
8.	Reassembled all parts.		
9.	Re-engaged power.		

APPROVED Yes _____ No _____

Evaluator's Signature **Date**

DUTY: PERFORMING GENERAL SKILLS

PERFORMANCE OBJECTIVE V-TECS 14

TASK: Service an engine governor.

STANDARD OF PERFORMANCE OF TASK:
Service the engine governor on the designated tractor. All worn parts will be replaced and the governor will function properly.

SOURCE OF STANDARD:
Kentucky Writing Team. Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a mechanic's tool set, shop manuals, replacement parts, and gasket compound, service an engine governor.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Use of hand tools.

RESOURCES:

1. Shop manual for tractor.
2. **Fundamentals of Service - Engine**, pp. 9-1 through 9-8.

TEACHING ACTIVITIES:

1. Explain the reasons for proper servicing of engine governor.
2. Discuss how to service an engine governor.
3. Demonstrate the proper way to service an engine governor.
4. Have student to list the steps in testing an engine governor for functioning.
5. Have student to service an engine governor.

CRITERION REFERENCED MEASURE:

Practical Application:
Given necessary tools, equipment, shop manual, replacement parts, and gasket compound, service an engine governor.

Method of Evaluating Practical Application:
Using the Checklist for PO #14, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 14 EVALUATION

PERFORMANCE TEST FOR SERVICING AN ENGINE GOVERNOR

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a mechanic's tool set, shop manual, replacement parts and gasket compound, service an engine governor. The service must include completion of all steps on the instructor checklist.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Tested engine governor for functioning.	____	____
2.	Checked engine idle with correct carburetor adjustment.	____	____
3.	Checked operation of engine under load.	____	____
4.	Removed governor and disassembled.	____	____
5.	Replaced all worn parts and installed new gaskets.	____	____
6.	Reassembled and installed governor.	____	____
7.	Tested for proper functioning.	____	____

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

DUTY: PERFORMING GENERAL SKILLS

PERFORMANCE OBJECTIVE V-TECS 15

TASK: Service hydraulic governor (diesel).

STANDARD OF PERFORMANCE OF TASK:
Service the designated hydraulic governor. When service is completed, the governor will operate according to manufacturer's specifications.

SOURCE OF STANDARD:
Fundamentals of Operation - Engines, Deere and Company, Moline, Ill., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Using a diesel engine having a faulty hydraulic governor, follow the instructions in the manufacturer's service manual to service the governor.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Use of hand tools.

RESOURCES:

1. Service manual for tractor
2. **Fundamentals of Operation - Engine,** pp. 9-5 through 9-6.

TEACHING ACTIVITIES:

1. Discuss the reasons for proper governor service.
2. Explain the steps involved in servicing a hydraulic governor.
3. Demonstrate how to service a hydraulic governor.
4. Answer student questions concerning the servicing of a hydraulic governor.
5. Have student service a hydraulic governor.

CRITERION REFERENCE MEASURE:

Practical Application:
Given a diesel engine having faulty hydraulic governor, a service manual, and the necessary tool, service the hydraulic governor.

Method of Evaluating Practical Application:
When service is completed, the governor will operate according to manufacturer's specification.

PERFORMANCE OBJECTIVE V-TECS 15

PERFORMANCE GUIDE:

1. Follow directions in manufacturer's service manual for complete instructions.
2. Check for erratic? engine operation, misfiring or hunting:
   a. Governor idle spring is missing or adjusted incorrectly--replace or adjust spring.
   b. Governor control spring is worn or broken--remove and replace.
   c. Governor is not operating because of worn parts, binding, sticking, or is incorrectly assembled--check service manual, disassemble, inspect, replace parts if necessary.
   d. Governor spring is incorrect--remove to replace with correct spring.
   e. Governor high idle adjustment is incorrect--adjust governor to diesel? pump specifications.
   f. Governor adjusting screw is not adjusted--adjust.
3. If engine does not receive fuel, check for worn, sticking, binding, or incorrect assembly. Take apart and repair or replace.
4. If engine idle speed is faulty, check to see if:
   a. Governor idle spring is missing or adjusted incorrectly;replace or adjust.
   b. Governor not operating because of worn, binding, sticking or incorrect assembly--disassemble and repair or replace parts.
   c. Wrong or extended governor spring--remove and replace.
5. If engine does not develop full power or speed, check to see if:
   a. Governor not operating due to worn, binding or sticking parts, or incorrect assembly--take apart and repair or replace.
   b. Incorrect governor spring--remove and replace.
   c. Improper adjustment of adjusting screw--adjust governor screw.
6. Clean all parts as recommended in the service manual and reassemble and check, following instructions in the service manual.

DUTY: PERFORMING GENERAL SKILLS

PERFORMANCE OBJECTIVE V-TECS 16

TASK: Service power take-off drive.

STANDARD OF PERFORMANCE OF TASK:
Service the power take-off drive on the designated tractor. The service should include the completion of all the steps on the instructor's checklist.

SOURCE OF STANDARD:
Tractor Operation and Daily Care, American Association for Vocational Instructional Materials, 1970.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a tractor with power take-off drive and necessary tools and supplies, service the power take-off drive.

ENABLING OBJECTIVE(S):

1. Use of hand tools.
2. Ability to read.

RESOURCES:

1. **Tractor Operation and Daily Care,** pp. 49-1 through 49-5.
2. **Fundamentals of Service - Power Trains,** pp. 9-1 through 9-7.

TEACHING ACTIVITIES:

1. Discuss reasons for proper service of power take-off drive.
2. Compare the two different power take-off speeds.
3. Explain the steps in servicing a power take-off drive.
4. Have the student to list the steps in servicing a power take-off drive.
5. Have the students service power take-off drive.

CRITERION REFERENCED MEASURE:

Practical Application:
Given necessary tools and equipment, service power take-off drive.

Method of Evaluating Practical Application:
Using the Checklist for PO #16, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 16 EVALUATION

PERFORMANCE TEST FOR SERVICE POWER TAKE-OFF DRIVE

Student's Name **Date**

DIRECTIONS TO STUDENT: Service power take off drive. All steps on checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe the student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Prepared tractor for service.		
2.	Determined shaft speed.		
3.	Checked power take-off and spline couplings.		
4.	Cleaned and oiled outside spline.		

APPROVED Yes ___ No ___

Evaluator's Signature Date

DUTY: PERFORMING GENERAL SKILLS

PERFORMANCE OBJECTIVE V-TECS 17

TASK: Service special drive (belt, chain, gear, and variable speed).

STANDARD OF PERFORMANCE OF TASK:
Service the special drives on the designated tractor. All parts will be clean, lubricated and adjusted to specified tension in service manual.

SOURCE OF STANDARD:
Fundamentals of Service - Power Trains, Deere and Company, Moline,ILL., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Given service manuals for specific drives, solvents, lubricants, and the needed tools, service the special drives on the designated tractor.

ENABLING OBJECTIVE(S):

1. Use of hand tools.
2. Ability to read.

RESOURCES:

1. **Fundamentals of Service - Power Trains,** pp. 10-1 through 10-9.
2. **Fundamentals of Service - Electrical Systems,** pp. 8-2 through 8-3.

TEACHING ACTIVITIES:

1. Discuss the different type of special drives.
2. Have students to list the different types of special drives.
3. Show students the proper way to service special drives.
4. Explain the steps in servicing special drives.
5. Have student to perform task of service special drives (belt, chain, gear, and variable speed).

CRITERION REFERENCED MEASURE:

Practical Application:
Given service manuals for specific drives, solvents, lubricants, and the needed tools, serve the special drives on a designated tractor.

Method of Evaluating Practical Application:
All parts will be clean, lubricated and adjusted to specified tension in service manual.

PERFORMANCE OBJECTIVE V-TECS 17

PERFORMANCE GUIDE:

1. Belt drives. (Note: There are three basic types of belt drives--flat belts, V-belts, and round belts. These may be made of leather, rubber, fabric, steel, wire, or in combinations. They may take an opened, turned, crossed, serpentine or mule forms).
    a. Check for signs of improper installation (belt stretches beyond take up, fails for no visible reason, turns over, cut on bottom, creeps or slips). Replace or adjust.
    b. Check condition of pulleys and smooth or adjust as needed.
    c. Check belt alignment and tension. Adjust to specifications.
    d. Clean belt of oil and grease with cloth and solvent. Add belt dressing if recommended by manufacturers.
    e. Clean belt shields and screens.
2. Chain drives. (Note: There are three basic types of chains--plain, roller, and silent).
    a. Remove connector link and clean chain in solvent. Lubricate.
    b. Clean driving sprocket, driver sprocket, and adjustable idler sprocket with brush and solvent. Lubricate.
    c. With connector link removed, wrap chain around sprockets bringing free ends together on one sprocket and install connector link. Tap chain pin links back so that fasteners are snug against the connecting link plate.
    d. Adjust chain tension on adjustable idler sprocket.
3. Gear drives: Check manufacturer's manual for type of lubricant.
    a. Open gears can be lubricated by:
        1. Splash pan which gears run through;
        2. Hand lubrication by brushing or squirting;
        3. Use of a drip oiler.
    b. Check gear for excessive wear, breaks or cracks, and replace if necessary.
4. Variable speed gears are variations on the above gears. Follow instructions given here and in the service manual.
    a. Clean.
    b. Lubricant if indicated.
    c. Adjust tension.

DUTY: PERFORMING GENERAL SKILLS

PERFORMANCE OBJECTIVE V-TECS 18

TASK: Service a torque converter.

STANDARD OF PERFORMANCE OF TASK:
Service a torque converter on the designated tractor. The entire unit will be tested and adjusted to specifications. Worn or damage parts will be repaired or replaced, and the converter will operate to specifications.

SOURCE OF STANDARD:
Fundamentals of Service - Power Trains, Deer and Company, Moline,ILL., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Using the manufacturer's service manual, the recommended tools and testing equipment, and replacement parts, service a torque converter. Disassembly and reassembly will be in the order specified in the service manual.

ENABLING OBJECTIVE(S):

1. Use of hand tools.
2. Be able to read manuals.

RESOURCES:

1. Tractor service manual.
2. **Fundamentals of Service - Power Trains,** pp. 6-12 through 6-13.

TEACHING ACTIVITIES:

1. Explain the purpose and function of the torque converter.
2. Discuss the importance of servicing a torque converter.
3. List the steps in servicing a torque converter.
4. Demonstrate how a torque converter is serviced.
5. Have the student to service a torque converter.

CRITERION REFERENCED MEASURE:

Practical Application:
Using the manufacturer's service manual, the recommended tools and testing equipment, and replacement parts, service a torque converter on a designated tractor.

Method of Evaluating Practical Application:
Disassembly and reassembly will be in the order specified in the service manual, and the converter must operate to service manual specifications.

PERFORMANCE OBJECTIVE V-TECS 18

PERFORMANCE GUIDE:

1. Following instructions in the manufacturer's service manual, remove all parts necessary to reach the torque converter.
2. Check the fluid level and adjust to correct level if necessary.
3. Start and warm the engine and transmission to operating temperature.
4. Shift into each gear and run engine in each gear for 15-20 seconds. Checking the selector valve, detent positions against the position on the shift indicator, if there is one.
5. Check actual oil levels against service manual recommendations and adjust if needed.
6. When starting, running, and stopping, check the gauges for pressure and temperature. Make adjustments if necessary.
7. Check for leaks, crimped oil lines, and clogged filters, and repair or replace if needed.
8. Examine the oil for water, dirt, or particles.
9. Listen for grinding or grating sounds and squealing sounds from a stuck valve. Locate source if need be, and repair, replace, or adjust the cause.
10. Check for the odor of overheating oil and if present, check for:
    - a. Air in the fluid system. Expel.
    - b. Plugged cooler core, low coolant level, and defective water pump in the water cooled systems. Correct.
    - c. Low fluid level clogged filter, excessive leaking past converter seals, restriction in oil line or defective oil pump. Repair or replace.
    - d. Slipping clutches in the planetary gear sets, repair or replace.
    - e. Worn edges and pits on vanes of pumps, stator or turbines. Repair or replace.
11. Check out entire unit with checking tools recommended by the manufacturer (unit includes engine, converter, and gear train). Make necessary adjustments, repairs, and/or replacements.
12. Reassemble all parts according to instructions in the service manual.

DUTY: PERFORMING GENERAL SKILLS

PERFORMANCE OBJECTIVE V-TECS 19

TASK: Service universal joints.

STANDARD OF PERFORMANCE OF TASK:
Service a universal joint on the designated tractor. There will be no damage to any parts, new bearings and seals will be installed, and there will be no roughness or binding in the new bearings and seals.

SOURCE OF STANDARD:
Motors Auto Repair Manual, 31st ed., Motor, 250 W. 55th Street, New York, 1968.

CONDITIONS FOR PERFORMANCE OF TASK:
Given new parts as needed, lubricant, a manufacturer's service manual, and the necessary tools, service a universal joint.

ENABLING OBJECTIVE(S):

1. Use of hand tools.
2. Ability to read.

RESOURCES:

1. Manufacturer's service manual.
2. Deere and Company, **Fundamentals of Service-Power Trains**, pp. 9-1 through 9-7.

TEACHING ACTIVITIES:

1. Discuss reasons for servicing a universal joint.
2. Explain the purpose of the universal joint.
3. List the steps in servicing a universal joint.
4. Demonstrate how to service a universal joint.
5. Have student service a universal joint.

CRITERION REFERENCED MEASURE:

Practical Application:
Given necessary tools, equipment, and service manual, service a universal joint on a designated tractor.

Method of Evaluating Practical Application:
The universal joint will be serviced to manufacturer's specifications. There will be no roughness or binding in the new bearings and seals.

PERFORMANCE OBJECTIVE V-TECS 19

PERFORMANCE GUIDE:

Note: The three common types of universal joints are (1) cross and roller, (2) ball and trunnion, and (3) constant velocity. There are several variations on each type. Check manufacturer's service manual for specific details. The following instructions are for a cross and roller type.

1. Note position of grease fittings (if used) and mark the yokes in relation to the propeller shaft for reassembly purposes later.
2. Remove retainer plates (or snap rings) that hold bearings in yoke and drive shaft.
3. Place universal joint in a vise. Select a wrench socket with an outside diameter and slightly smaller than universal joint bearings, and select another wrench socket with an inside diameter slightly larger than the universal joint bearings. Place sockets at opposite bearings in the yoke so that the smaller socket becomes a bearing pusher and the larger becomes a bearing receiver.
4. Close vise jaws until both bearings are free of the yoke, and remove bearings from the cross or spider. (A hydraulic press may also be used).
5. Check service manual for detailed instructions if bearings will not come all the way out.
6. Remove yoke from drive shaft and press bearings out of the drive shaft.
7. Clean and examine all parts, replacing parts with damage or excessive wear. (If old parts are to be reassembled, pack bearings cups with universal joint grease. If new parts are being installed, check new bearings for adequate grease). Use new seals.
8. With pusher socket, press one bearing part way into drive shaft. Position spider into partially installed bearing and place second bearing into drive shaft.
9. Put drive shaft in vise so that bearings are in contact with faces of vise jaws.
10. Press bearings into position and install snap rings or retainer plates.
11. Install bearings in yoke in same manner. Check universal joints for roughness and binding, and correct the condition if necessary prior to installation in tractor.

DUTY: PERFORMING GENERAL SKILLS

PERFORMANCE OBJECTIVE V-TECS 20

TASK: Test engine compression.

STANDARD OF PERFORMANCE OF TASK:
Test the engine compression on the designated tractor. Student readings should be within ± 5% of the instructor's readings.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a compression tester and a spark plug wrench, test the compression on an engine.

ENABLING OBJECTIVE(S):

1. Know safety procedures in testing compression.
2. Use of hand tools.

RESOURCES:

1. Manufacturer's service manual.
2. **Fundamentals of Service - Engine**, pp. 1-27 through 1-28.

TEACHING ACTIVITIES:

1. Explain what compression means.
2. Describe different methods of checking compression.
3. List the safety precautions in testing compression.
4. Demonstrate the proper way to test engine compression.
5. Have the student to test engine compression.

CRITERION REFERENCED MEASURE:

Practical Application:
Given the necessary tools and equipment test the compression on a designated tractor.

Method of Evaluating Practical Application:
Using the Checklist for PO #20, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 20 EVALUATION

PERFORMANCE TEST FOR TESTING ENGINE COMPRESSION

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a compression tester and a spark plug wrench, test the compression on a designated tractor. The service must include satisfactory completion of all steps on instructor checklist and student readings should be within ± 5% of the instructor's readings.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Ran engine until normal operating temperature was reached.	______	______
2.	Removed all spark plugs.	______	______
3.	Opened throttle all the way.	______	______
4.	Placed the gauge in one spark plug hole.	______	______
5.	Cranked the engine until no more rise in pressure on the gauge was apparent.	______	______
6.	Recorded the compression reading.	______	______
7.	Repeated for each spark plug hole.	______	______
8.	Checked specification for compression.	______	______
9.	Checked the reading that the instructor took.	______	______

APPROVED Yes ___ Yes ___

Evaluator's Signature **Date**

DUTY: PERFORMING GENERAL SKILLS

PERFORMANCE OBJECTIVE V-TECS 21

TASK: Use the dynamometer.

STANDARD OF PERFORMANCE OF TASK:
Test the horsepower, exhaust, fuel consumption, and crankcase blow-by on the designated tractor using the dynamometer. The dynamometer will be connected according to manufacturer's instructions and the student's readings will agree with those of the instructor.

SOURCE OF STANDARD:
Preventive Maintenance, Deere and Company, Moline, ILL., 1973.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a dynamometer complete with operating instructions, the manufacturer's service manual for the tractor to be tested and any needed tools, test the horsepower, exhaust, fuel consumption, and crankcase blow-by on the designated tractor.

ENABLING OBJECTIVE(S):

1. Ability to read.

RESOURCES:

1. Manufacturer's service manual.
2. **Preventive Maintenance**, pp. 76-77

TEACHING ACTIVITIES:

1. Explain the purpose of a dynamometer.
2. Discuss the reasons for using a dynamometer.
3. Show student proper procedure in using a dynamometer.
4. Have the student use the dynamometer.
5. Compare instructor's reading with the student's reading.

CRITERION REFERENCED MEASURE:

Practical Application:

Given a dynamometer complete with operating instructions, the manufacturer's service manual for the tractor to be tested and any needed tools, test the horsepower, exhaust, fuel consumption, and crankcase blow- by on a designated tractor.

Method of Evaluating Practical Application:

The dynamometer will be connected according to manufacturer's instructions and student reading will agree with those of the instructor.

PERFORMANCE OBJECTIVE V-TECS 21

PERFORMANCE GUIDE:

1. Following manufacturer's instructions, connect the dynamometer to the machine.
2. Operate the engine for 30 minutes at one-half load to get coolant and crankcase oil temperatures up to normal.
3. Increase the load on the engine gradually until the speed is reduced to the rated load speed given in the manufacturer's service manual, and take reading of the horsepower on the dynamometer.
4. Compare reading with that given in the service manual.
5. Following manufacturer's instructions test for: exhaust analysis, smoke analysis, diesel, and carburetor adjustment (spark ignition), and crankcase blow-by.

Note: If indicated, tune-up or overhaul the engine by following instructions in the service manual.

Use the dynamometer after tune-up or overhaul to determine horsepower output and fuel consumption.

MAINTAINING AND SERVICING STORAGE BATTERY

DUTY: MAINTAINING AND SERVICING STORAGE BATTERY

PERFORMANCE OBJECTIVE V-TECS 22

TASK: Activate dry-charged batteries.

STANDARD OF PERFORMANCE OF TASK:
Activate a dry-charged battery in the shop area. The electrolyte should be 3/8 inch above the plates. The reading on the voltmeter will be within one volt of the measurement obtained by the instructor.

SOURCE OF STANDARD:
Kentucky Writing Team - Incumbent Worker.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a dry-charged battery, electrolyte, service manual, protective equipment, battery syringe or manufacturer's dispenser, and a battery charger, activate the battery.

ENABLING OBJECTIVE(S):

1. Read 1/16th ruler.
2. Use fluid measurement.

RESOURCES:

1. Manufacturer's instruction manual.
2. Jacobs/Harrell, **Agricultural Power and Machinery**, pp. 201-203.
3. AAVIM, **Tractor Maintenance**, pp. 7-14.
4. Phillips, **Mechanics in Agriculture**, pp. 361-363.

TEACHING ACTIVITIES:

1. Have students to write procedures for activating dry charge battery.
2. The class will discuss and demonstrate safety procedures in using chemicals and electrical equipment.
3. Identify the proper electrolyte for task being performed.
4. Demonstrate use of voltmeter and battery syringe.
5. Have students to charge the dry charge battery.
6. List 5 safety steps in charging a dry battery.

CRITERION REFERENCED MEASURE:

Practical Application:
Given access to the necessary items, activate a dry charge battery.

Method of Evaluating Practical Application:
Using the check list for PO #22, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 22 EVALUATION

PERFORMANCE TEST FOR ACTIVATING DRY CHARGE BATTERY

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a dry-charged battery, electrolyte, service manual, battery syringe and a battery charger, activate the battery. The electrolyte should be 3/8" above the plates and the voltmeter reading will be within one volt of the instructors reading.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1.	Removed battery caps and filled cells 3/8" above plates with electrolyte using a syringe.		
2.	Hooked up battery charger properly.		
3.	Cleaned and reinstalled battery caps.		
4.	Checked voltage with voltmeter.		
5.	Followed all safety precautions.		

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING STORAGE BATTERY

PERFORMANCE OBJECTIVE V-TECS 23

TASK: Charge a wet cell battery.

STANDARD OF PERFORMANCE OF TASK:
In the shop area, charge a wet cell battery. Electrolyte level should be 3/8" above plate. The hydrometer reading by the student should be exactly the same as the instructor's reading on each cell.

SOURCE OF STANDARD:
Kentucky Writing Team - Incumbent Worker.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a wet cell battery, and a hydrometer, charge the battery.

ENABLING OBJECTIVE(S):

1. Ability to follow directions.
2. Use of hand tools.
3. Ability to read.

RESOURCES:

1. Jacobs/Harrell, **Agricultural Power and Machinery**, pp. 202-203.
2. AAVIM, **Tractor Maintenance**, pp. 7-14.

TEACHING ACTIVITIES

1. Demonstrate safety procedures used in charging a battery.
2. List steps in using the hydrometer.
3. Explain the meaning of the different readings found on the hydrometer.
4. Have students prepare a wet cell battery for charging.
5. Have students to distinguish weak or dead cells from properly charged cells.
6. Demonstrate reading the voltmeter and hydrometer.

CRITERION REFERENCED MEASURE:

Practical Application:
The student will charge a wet cell battery. The hydrometer readings will agree with the instructors reading and electrolyte will be 3/8" above plates.

Method of Evaluating Practical Application:
Use the checklist for PO #23. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 23 EVALUATION

PERFORMANCE TEST FOR CHARGING A WET CELL BATTERY

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a wet cell battery, a battery charger, and a hydrometer, charge the battery. Hydrometer readings must agree with instructors readings and electrolyte must be 3/8" above plates. All steps on check list must be completed.

DIRECTIONS TO EVALUATOR: Provide needed equipment and supplies. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1. Checked electrolyte level. Added distilled water if needed.		
2. Checked specific gravity.		
3. Properly connected charger cables and turned charger on. Be sure this is done in this order to avoid sparks.		
4. Charged battery at moderate rate (avoid excessive boiling).		
5. Checked battery periodically to determine degree of charge.		
6. Turned off and removed charger when battery reached full charge.		

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING STORAGE BATTERY

PERFORMANCE OBJECTIVE V-TECS 24

TASK: Clean battery terminals, cables, and battery box.

STANDARD OF PERFORMANCE OF TASK:
Clean the battery terminals, cables, and battery box on the designated tractor battery. The cleaned parts should show no visible signs of dirt, moisture, or acid.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a dirty battery, a box end wrench set, clamp puller, terminal cleaning brush, sandpaper, baking soda, carrying strap, and rags, clean the battery terminals, cables, and battery box.

ENABLING OBJECTIVE(S):

1. Know shop safety.
2. Use of hand tools.

RESOURCES:

1. AAVIM, **Tractor Maintenance**, p. 63.
2. Jacobs/Harrell, **Agricultural Power and Machinery**, p. 201.
3. Phillips, **Mechanics in Agriculture**, pp. 362 and 363.

TEACHING ACTIVITIES:

1. Discuss the importance of cleaning a battery.
2. Explain the effect of baking soda on acid.
3. Demonstrate the procedure for cleaning a battery.
4. Explain the effects of charging and discharging of a battery on the outer surface of the battery.
5. List 5 reasons why cleaning a battery will increase its life.
6. List and identify the parts of the battery that need to be cleaned.

CRITERION REFERENCED MEASURE:

Practical Application:
Student will properly clean the battery terminals, cables and box.

Method of Evaluating Practical Application:
Use the checklist for PO #24. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 24 EVALUATION

PERFORMANCE TEST FOR CLEANING BATTERY TERMINALS, CABLES AND BATTERY BOX

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a dirty battery, a box end wrench set, clamp puller, terminal cleaning brush, sandpaper, baking soda, carrying strap, and rags, clean the battery terminals, cables and battery box. Cleaned parts should show no signs of dirt, moisture or acid. All steps in the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Disconnected battery ground cable first, using box end wrenches.	______	______
2.	Loosened hold down clamps.	______	______
3.	Removed battery from tractor.	______	______
4.	Cleaned battery terminals, cables, and battery box and flushed with clean water.	______	______
5.	Dried battery with clean rags.	______	______
6.	Replaced battery in tractor.	______	______
7.	Tightened hold down clamps.	______	______
8.	Connected battery (ground cable last).	______	______

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING STORAGE BATTERY

PERFORMANCE OBJECTIVE V-TECS 25

TASK: Measure the specific gravity of a battery using a hydrometer.

STANDARD OF PERFORMANCE OF TASK:
Using a hydrometer, measure the specific gravity of the designated battery. The measurement should be exactly the same as the instructor's measurement on all cells.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a battery, hydrometer, and a specific gravity explanation chart, measure the specific gravity in each battery cell.

ENABLING OBJECTIVE(S):

1. Be able to add and subtract three digit decimals numbers.
2. Ability to read.

RESOURCES:

1. AAVIM, **Tractor Maintenance**, pp. 11 to 14.
2. AAVIM, **Tractor Maintenance**, Transparency
3. Jacobs/Harrell, **Agricultural Power and Machinery**, p. 194.
4. Phillips, **Mechanics in Agriculture**, p. 362.

TEACHING ACTIVITIES:

1. Show and discuss transparency on using hydrometer.
2. Discuss the safety practices needed to accomplish the task.
3. Explain what a low reading or a high reading indicates.
4. List steps used to acquire proper specific gravity readings.
5. Demonstrate the proper way to use the hydrometer.
6. Explain how temperature effects the specific gravity reading.

CRITERION REFERENCED MEASURE:

Questions:

1. List 5 steps to insure safety while working with batteries.
2. Explain the following specific gravity. Reading indicates 1.3, 1.23 and 1.220.

Answers:

1. a. Always wear safety glasses.
   b. If needed get help with lifting a battery.
   c. Keep all open flame and sparks away from batteries.
   d. Always disconnect the ground cable first and reconnect last.
   e. Should the battery spill, flush immediately with water.

Criterion Referenced Measure Continued

2. 1.3 battery electrolyte level is low, battery is overcharging.
   1.23 battery is in good condition.
   1.220 battery charge is too low.

Practical Application:

The student will measure the specific gravity of a battery using a hydrometer.

Method of Evaluating Practical Application:

Using the checklist for PO #25. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 25 EVALUATION

PERFORMANCE TEST FOR MEASURING THE SPECIFIC GRAVITY OF A BATTERY USING HYDROMETER

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a battery, hydrometer, and a specific gravity explanation chart, measure the specific gravity in each battery cell. All readings should agree with instructor's reading. All steps on the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Squeezed hydrometer bulb to draw electrolyte.		
2.	Adjusted electrolyte level.		
3.	Float at eye level, read scale.		
4.	Took temperature of the electrolyte. Added .004 to reading for each 10° above 80°F and subtracted .004 for each 10° below 80°F.		
5.	Cleaned hydrometer with clean water between each cell.		
6.	Checked each cell.		
7.	Interpreted reading by using specific gravity chart.		

APPROVED Yes ___ No ___

Evaluator's Signature Date

DUTY: MAINTAINING AND SERVICING STORAGE BATTERY

PERFORMANCE OBJECTIVE V-TECS 26

TASK: Measure the voltage of a battery using the voltmeter.

STANDARD OF PERFORMANCE OF TASK:
Using a voltmeter, measure the voltage on the designated battery. The obtained measurement should be within one volt of the measurement obtained by the instructor.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a battery and a voltmeter with regular or expanded scale divisions, measure the battery voltage.

ENABLING OBJECTIVE(S):

1. Ability to read.

RESOURCES:

1. None

TEACHING ACTIVITIES:

1. List safety steps needed when working with a battery.
2. Discuss the steps used in hooking up the voltmeter.
3. Demonstrate the correct steps in hooking up the voltmeter.
4. Explain why turning the starter on will effect voltmeter reading.
5. Interpret different reading of the voltmeter.

CRITERION REFERENCED MEASURE:

Questions:

1. List 5 safety steps in working with a battery.
2. Define a high reading and a low reading of the voltmeter.

Answers:

1. a. Always wear safety glasses.
    b. If needed get help with lifting a battery.
    c. Keep all open flame and sparks away from batteries.
    d. Always disconnect the ground cable first and reconnect last.
    e. If battery spills on you, flush immediately with water.

2. High reading - battery is over charged or charge is normal.
    Low reading - battery is either bad or it is discharged.

PERFORMANCE OBJECTIVE V-TECS 26

Criterion Referenced Continued:

Practical Application:
The student will measure battery voltage using a voltmeter. Measurement must be within one volt of instructor's readings.

Method of Evaluating Practical Application:
Use the checklist for PO #26. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 26 EVALUATION

PERFORMANCE TEST FOR MEASURING THE VOLTAGE OF A BATTERY USING THE VOLTMETER

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a battery and a voltmeter with regular or expanded scale divisions, measure the battery voltage. Readings must be within one volt of instructor's readings. All steps in check list must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1.	Connected positive lead of the voltmeter to the positive post of the battery.	____	____
2.	Connected negative lead of the voltmeter to the negative post of the battery.	____	____
3.	Disconnected coil wire from distributor cap.	____	____
4.	Turned starter switch just long enough to get a reading.	____	____
5.	Disconnected leads from battery and replaced coil wire.	____	____
6.	Interpreted voltage reading and determined if battery needs charging.	____	____

APPROVED Yes ___ No ___

Evaluator's Signature Date

DUTY: MAINTAINING AND SERVICING STORAGE BATTERY

PERFORMANCE OBJECTIVE V TECS 27

TASK: Run a load test on a battery.

STANDARD OF PERFORMANCE OF TASK:
Run a load test on the designated battery using testing machine. Recorded results should not vary more than .2 volt from the instructor's.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a hydrometer, load- test machine and voltmeter, run a load test on a battery. The voltage should not drop below 4.5 volts on a 6-volt battery nor 9.0 on a 12-volt battery.

ENABLING OBJECTIVE(S):

1. Ability to read.

RESOURCES:

1. Manufacturer's Instructions Sheet for hydrometer and voltmeter.
2. AAVIM, **Tractor Maintenance**, pp. 11 to 14.

TEACHING ACTIVITIES:

1. Compare the results by a load test versus the hydrometer test.
2. List the steps in setting up the load test.
3. Set-up and demonstrate the load test.
4. Explain the result achieved by running the load test.
5. Identify a good battery by load test out of a group of three batteries.

CRITERION REFERENCED MEASURE:

Questions:

1. Explain steps used to perform a load test.
2. Explain why a load test gives better results than just a voltmeter reading.

Answers:

1. a. Connect the instrument to the battery.
   b. Remove the coil wire from distributor.
   c. Apply load to the battery.
   d. Read voltage.
2. Because a battery may have an internal electrical leak and will accept a charge. The leak will show up in a load test.

Criterion Referenced Measure Continued

Practical Application:

The student will run a load test on a battery, recorded results must be within .2 volts of instructor's readings.

Method of Evaluating Practical Application:

Use the checklist for PO #27. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V TECS 27 EVALUATION

PERFORMANCE TEST FOR RUNNING A LOAD TEST ON A BATTERY

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a hydrometer, load test machine and voltmeter, run a load test on a battery. Recorded readings must be within .2 volt of instructor's readings. All steps on checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1. Checked specific gravity.	___	___
2. Connected load test machine.	___	___
3. Ran load test with testing machine.	___	___
4. Recorded results.	___	___

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING STORAGE BATTERY

PERFORMANCE OBJECTIVE V TECS 28

TASK: Run a load test on a battery.

STANDARD OF PERFORMANCE OF TASK:
Run a load test on the designated tractor battery using the starting motor. The voltage should not drop below 4.5 volts on a 6-volt battery nor 9.0 on a 12-volt battery. Recorded results should not vary more than .2 volt from the instructor's.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a hydrometer and voltmeter, run a load test on a battery using the starting motor.

ENABLING OBJECTIVE:

1. Ability to read.

RESOURCES

1. Manufacturer's Instruction booklet.
2. AAVIM, **Tractor Maintenance**, pp. 11 to 14.

TEACHING ACTIVITIES:

1. List procedural steps in setting up the load test.
2. Explain the results achieved by running the load test.
3. Explain why the reading from the hydrometer is important before running the load test.
4. Set-up and demonstrate the load test.
5. Identify a good battery from a bad battery by using the load test.

CRITERION REFERENCED MEASURE:

Questions:

1. List 5 safety steps in running a load test.
2. Explain why a battery may drop in voltage.

Answers:

1. a. Remove the coil wire from distributor.
   b. Always wear safety glasses.
   c. Connect positive lead of voltmeter to the positive post of the battery.
   d. Keep open flames and sparks away from batteries.
   e. If accidently spilled on skin or clothing, rinse with water immediately.

2 Because a battery may have an internal or external leak.

PERFORMANCE OBJECTIVE V TECS 28

Practical Application:

The student will run a load test on a battery using the starting motor. Recorded results should be within .2 volt of instructor's reading.

Method of Evaluating Practical Application:

Use the checklist for PO #28. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 28 EVALUATION

PERFORMANCE TEST FOR RUNNING A LOAD TEST ON A BATTERY

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a hydrometer and voltmeter run a load test on a battery using the starting motor. Recorded results should be within .2 volts of instructor's readings. All steps on checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1.	Checked specific gravity.	______	______
2.	Had ignition off.	______	______
3.	Connected voltmeter to battery.	______	______
4.	Engaged starter for at least 15 seconds.	______	______
5.	Observed the battery voltage reading on the voltmeter.	______	______
6.	Recorded voltage reading.	______	______

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING STORAGE BATTERY

PERFORMING OBJECTIVE V-TECS 29

TASK: Tighten battery cables and battery hold down.

STANDARD OF PERFORMANCE OF TASK:
Tighten battery cables and battery hold down clamps on the designated tractor. When pressure is applied, neither the cables nor battery should move.

SOURCE FOR STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a battery with loose battery cables and battery hold down clamps, battery pliers, and a socket wrench, tighten the cables and hold down clamps.

ENABLING OBJECTIVE:

1. Use hand tools.

RESOURCES:

1. AAVIM, **Tractor Maintenance,** pp. 63-65.

TEACHING ACTIVITIES:

1. Demonstrate how to tighten the battery's cables and hold down.
2. Explain why loose cables will not work and are considered unsafe.
3. List tools needed to remove and replace a battery properly.
4. Identify the positive cable and the negative cable and the battery post on which each go.
5. Demonstrate how to tighten the battery cable and battery hold down.

CRITERION REFERENCED MEASURE:

Practical Application:
The student will tighten battery cables and battery hold down. When completed neither cables or battery should move.

Method of Evaluating Practical Application:
Use checklist for PO #29. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 29 EVALUATION

PERFORMANCE TEST FOR TIGHTENING BATTERY CABLES AND BATTERY HOLD DOWN

____

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a battery with loose battery cables and battery hold down clamps, battery pliers, and a socket wrench, tighten the cables and hold down clamps. When completed neither the battery or cables should move. All steps on checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Tightened battery cables.	______	______
2. Tightened battery hold down clamp.	______	______
3. Tested for tightness.	______	______

APPROVED Yes ___ No ___

____

Evaluator's Signature Date

DUTY: MAINTAINING AND SERVICING STORAGE BATTERY

PERFORMANCE OBJECTIVE V-TECS 30

TASK: Treat battery terminals to prevent corrosion.

STANDARD OF PERFORMANCE OF TASK:
Treat the battery terminals on the designated tractor to prevent corrosion. All areas that are subject to corrosion should be coated with light grease.

SOURCE OF STANDARD:
Kentucky Writing Team - Incumbent Worker.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a battery with clean terminals, and a supply of light grease, treat the battery terminals.

ENABLING OBJECTIVE(S):
1. Understand theory of electricity.
2. Use of hand tools.
3. Ability to read.

RESOURCES:
1. AAVIM, **Tractor Maintenance**, pp. 63-65.

TEACHING ACTIVITIES:
1. Demonstrate removal of battery cable from the battery.
2. List steps to prepare battery for applying the grease to prevent corrosion.
3. Show how to select proper lubricant to apply to the battery.
4. Demonstrate how to treat the battery post to prevent corrosion.
5. Explain what causes battery terminals and cables to form corrosion.

CRITERION REFERENCED MEASURE:

Questions:
1. What causes a battery to slowly discharge if allowed to remain unclean?
2. Explain how a coating of light grease prevents corrosion.

Answers:
1. Acid settles on battery top and may accumulate enough to provide electrical paths to ground.

2. The coating of grease will help to protect the terminal from getting the acid on them and by this way protect against the electrical paths to ground from forming.

PERFORMANCE OBJECTIVE V-TECS 30

Criterion Referenced Measure Continued:

Practical Application:
The student will treat battery terminals to prevent corrosion.

Method of Evaluating Practical Application:
Use the checklist for PO #30. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 30 EVALUATION

PERFORMANCE TEST FOR TREATING BATTERY TERMINALS TO PREVENT CORROSION

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a battery with clean terminals, and a supply of light grease, treat the battery terminals. All areas that are subject to corrosion should be coated with light grease. All steps on a checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Applied a thin layer of light grease.	______	______
2. Wiped off excess grease.	______	______
3. Properly disposed of soiled rags.	______	______

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

MAINTAINING AND SERVICING THE IGNITION CIRCUIT

DUTY: MAINTAINING AND SERVICING THE IGNITION CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 31

TASK: Measure resistance using ohmmeter.

STANDARD OF PERFORMANCE OF TASK:
Measure the resistance in a piece of ignition wire to within ± 5% of the specifications in the service manual.

SOURCE OF STANDARD:
Kentucky Writing Team - Incumbent Worker.

CONDITIONS FOR PERFORMANCE OF TASK:
Given an ignition wire, service manual, ohmmeter, and necessary tools and equipment, measure the resistance of the wire.

ENABLING OBJECTIVE(S):

1. Know shop safety practices.
2. Ability to read.

RESOURCES:

1. Operators manual for ohmmeter.
2. Service manual.

TEACHING ACTIVITIES:

1. Discuss shop safety.
2. Demonstrate calibration of ohmmeter.
3. Demonstrate use of ohmmeter to determine wire resistance.
4. Discuss resistance and the causes of resistance.
5. Have students check resistance in wire.

CRITERION REFERENCED MEASURE:

Practical Application:
Measure resistance in a given wire using an ohmmeter.

Method of Evaluation:
Using the checklist for PO #31. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 31 EVALUATION

PERFORMANCE TEST FOR MEASURING RESISTANCE USING OHMMETER

Student's Name **Date**

DIRECTIONS TO STUDENT: Measure the resistance in a piece of ignition wire. Resistance measured must be within ± 5° of specifications in service manual. All steps on checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Calibrated ohmmeter.	________	________
2.	Checked wire specifications in service manual.	________	________
3.	Properly attached ohmmeter leads to ignition wire.	________	________
4.	Correctly read ohmmeter seal and recorded reading.	________	________

APPROVED Yes ___ No ___

Evaluator's Signature Date

DUTY: MAINTAINING AND SERVICING THE IGNITION CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 32

TASK: Replace distributor points and condenser.

STANDARD OF PERFORMANCE OF TASK:
Replace the distributor points and condenser on the designated tractor. Point gap setting should be 100% accurate as specified in operator's manual.

SOURCE OF STANDARD:
Tractor Maintenance, Southern Association for Agricultural Engineering and Vocational Agriculture.

CONDITIONS FOR PERFORMANCE OF TASK:
Given distributor points and condenser, service manual, feeler gauge, dwell meter, and ignition wrench set, replace the points and condenser on the designated tractor.

ENABLING OBJECTIVE(S):

1. Use of hand tools.
2. Ability to read.
3. Knowledge of shop safety.

RESOURCES:

1. Service manual for tractor.

TEACHING ACTIVITIES:

1. Review shop safety.
2. Demonstrate use of dwell meter.
3. Identify ignition system parts.
4. Discuss purpose of points and related ignition systems parts.
5. Demonstrate removal of ignition system points and condenser.
6. Demonstrate replacement of ignition system points and condenser.

CRITERION REFERENCED MEASURE:

Practical Application:
Have student replace ignition system points and condenser. Point setting should agree 100% with manufacturer's specifications.

Method of Evaluating Practical Application:
Use the checklist for PO #32. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 32 EVALUATION

PERFORMANCE TEST FOR REPLACING DISTRIBUTOR POINTS AND CONDENSER

Student's Name **Date**

DIRECTIONS TO STUDENT: Replace ignition points and condenser. Point setting should agree 100% with manufacturer's specifications. All steps on checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Obtained specifications from operator's manual.	________	________
2.	Removed breaker arm and spring.	________	________
3.	Remove stationary breaker point bracket.	________	________
4.	Cleaned and lubricated cam.	________	________
5.	Replaced condenser.	________	________
6.	Installed new points.	________	________
7.	Set points with feeler gauge.	________	________
8.	Checked point setting with dwell meter.	________	________

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING THE IGNITION CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 33

TASK: Replace ignition distributor.

STANDARD OF PERFORMANCE OF TASK:
Replace the ignition distributor on the designated tractor. Replacement should include the completion of all the steps on an instructor's checklist.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given an ignition distributor, operator's manual, and necessary tools, replace the ignition distributor on the designated tractor.

ENABLING OBJECTIVE(S):
1. Know shop safety practices.
2. Use of hand tools.
3. Ability to read.

RESOURCES:
1. I. & T. Shop Service Manual.

TEACHING ACTIVITIES:
1. Discuss shop safety.
2. Discuss distributor function.
3. Discuss the function and demonstrate the use of timing light to set ignition timing.
4. Define and explain dwell.
5. Demonstrate the use of the dwell meter.
6. Demonstrate the removal and replacement of the distributor.

CRITERION REFERENCED MEASURE:

Practical Application:
Student will replace ignition distributor. All steps on checklist will be completed.

Method of Evaluating Practical Application:
Use checklist for PO #33. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 33 EVALUATION

PERFORMANCE TEST FOR REPLACING IGNITION DISTRIBUTOR

Student's Name **Date**

DIRECTIONS TO STUDENT: Replace ignition distributor. All steps on checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1. Removed primary and secondary ignition wires from distributor.	______	______
2. Noted position of rotor.	______	______
3. Loosened bolts and removed old distributor.	______	______
4. Installed new distributor.	______	______
5. Reconnected primary and secondary ignition wires.	______	______
6. Set ignition timing using timing light.	______	______
7. Set breaker points using dwell meter.	______	______

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING THE IGNITION CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 34

TASK: Replace ignition wire.

STANDARD OF PERFORMANCE OF TASK:
Replace the primary ignition wire on the designated tractor. The replaced wire should be properly connected to distributor and coil.

SOURCE OF STANDARD:
Kentucky Writing Team - Incumbent Worker.

CONDITIONS FOR PERFORMANCE OF TASK:
Given necessary tools, equipment, wire material, and operator's manual, replace the primary ignition wire on the designated tractor. Wire size and resistance reading should be 100% accurate as indicated by manufacturer's specifications.

ENABLING OBJECTIVE(S):

1. Know how to use ohmmeter
2. Ability to read specifications.
3. Use of hand tools.

RESOURCES:

1. Service manual for tractor.
2. Operator's instructions for ohmmeter.

TEACHING ACTIVITIES:

1. Explain wiring diagrams and their purpose.
2. Discuss the need for proper wiring.
3. Discuss resistance in wires.
4. Explain the difference in primary and secondary ignition wires.
5. Demonstrate use of ohmmeter to measure resistance.
6. Demonstrate terminal replacement using crimpers.

CRITERION REFERENCED MEASURE:

Practical Application:
Student will replace ignition wire. Wire size and resistance must agree with manufacturer's specifications.

Method of Evaluating Practical Application:
Use checklist for PO #34. All steps must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 34 EVALUATION

PERFORMANCE TEST FOR REPLACING IGNITION WIRE

Student's Name **Date**

DIRECTIONS TO STUDENT: Replace the primary ignition wire. Wire size and resistance must agree 100% with manufacturer's specifications. All steps on checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Determined wire size from service manual.	____	____
2.	Identified end of primary wire.	____	____
3.	Removed wire.	____	____
4.	Checked wire resistance using ohmmeter.	____	____
5.	Checked wire size.	____	____
6.	Cut new wire to proper length.	____	____
7.	Replaced terminal with crimpers.	____	____
8.	Checked new wire with ohmmeter for agreement with manufacturer's specifications.	____	____
9.	Replaced wire and connected to system.	____	____

APPROVED Yes ___ No ___

Evaluator's Signature Date

DUTY: MAINTAINING AND SERVICING THE IGNITION CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 35

TASK: Replace ignition wire.

STANDARD OF PERFORMANCE OF TASK:
Replace the secondary ignition wires on the designated tractor. The replaced wire should be properly connected to the distributor and spark plugs. Wire size and resistance reading should be 100% accurate as indicated by manufacturer's specifications.

SOURCE FOR STANDARD:
Kentucky Writing Team - Incumbent Worker.

CONDITIONS FOR PERFORMANCE OF TASK:
Given necessary tools, equipment, material, and operator's manual, replace the secondary ignition wires.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Use of hand tools.

RESOURCES:

1. Service manual for tractor.
2. Operators instructions for ohmmeter.

TEACHING ACTIVITIES:

1. Explain the need for proper wire size and wiring.
2. Discuss wiring diagrams.
3. Explain how to locate secondary wires.
4. Demonstrate use of ohmmeter to measure resistance in wiring.
5. Demonstrate the proper procedures to prepare new secondary wires.

CRITERION REFERENCED MEASURE:

Practical Application:
Student will replace secondary ignition wires. Replaced wires must be properly connected.

Method of Evaluating Practical Application:
Use checklist for PO #35. All steps must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 35 EVALUATION

PERFORMANCE TEST FOR REPLACING IGNITION WIRE

Student's Name **Date**

DIRECTIONS TO STUDENT: Replace secondary ignition wire. All replaced wires must be properly connected to distributor and spark plugs and all steps on checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Obtained wire size information from service manual.	____	____
2.	Determined rotation and firing order.	____	____
3.	Remove and numbered spark plug wires.	____	____
4.	Cut new wires to specified length or resistance as specified by manufacturer.	____	____
5.	Installed dust covers.	____	____
6.	Installed terminal and crimped	____	____
7.	Reinstalled wires properly.	____	____
8.	Checked operation.	____	____

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING THE IGNITION CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 36

TASK: Service spark plugs.

STANDARD OF PERFORMANCE OF TASK:
Clean and service a spark plug and set the gap to 100% accuracy as specified by the operator's manual.

SOURCE OF STANDARD:
Kentucky Writing Team - Incumbent Worker.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a spark plug, an operator's manual, and the necessary tools and equipment, service the plug.

ENABLING OBJECTIVE(S):

1. Know shop safety practices.
2. Ability to read.
3. Use of hand tools.

RESOURCES:

1. Operating instructions for spark plug cleaner.
2. Tractor Operators Manual.

TEACHING ACTIVITIES:

1. Discuss shop safety practices.
2. Explain need for cleaning spark plugs.
3. Explain how the spark plug cleaner works.
4. Demonstrate the use of the spark plug cleaner.
5. Discuss the importance of proper spark plug electrode gap.
6. Demonstrate the proper way to set spark plug gap.
7. Demonstrate the proper use of the torque wrench and the importance of using the torque wrench to install spark plugs.

CRITERION REFERENCED MEASURE:

Practical Application:
The student will clean and service a spark plug. The gap on the serviced plug will agree 100% with the manufacturer's specifications.

Method of Evaluating Practical Application:
Use checklist for PO #36. All items must be rated satisfactory.

CHECKLIST PERFORMANCE OBJECTIVE V-TECS 36 EVALUATION

PERFORMANCE TEST FOR SERVICING SPARK PLUGS

Student's Name **Date**

DIRECTIONS TO STUDENT: Clean and service a spark pug. The gap must agree 100% with specifications. All steps in checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Checked specifications for proper gap.	______	______
2.	Removed spark plug wire.	______	______
3.	Loosened plug and blew debris away with air hose.	______	______
4.	Removed spark plug from engine.	______	______
5.	Visually inspected spark plug for defects.	______	______
6.	Cleaned spark plug.	______	______
7.	Adjusted spark plug gap to specifications.	______	______
8.	Reinstalled spark plug and torqued to proper tightness.	______	______
9.	Reinstalled spark plug wire.	______	______

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING THE IGNITION CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 37

TASK: Set breaker point dwell using a dwell meter.

STANDARD OF PERFORMANCE OF TASK:
Set the breaker points on the designated tractor to 100% accuracy as specified by the operator's manual.

SOURCE OF STANDARD:
Tractor Maintenance, Southern Association for Agricultural Engineering and Vocational Agriculture.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a tractor with operational distributor, operator's manual, feeler gauge, dwell meter, and ignition tool set, set breaker points.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Use of hand tools.

RESOURCES:

1. Tractor manufacturer's service manual.
2. Operating instructions for dwell meter.

TEACHING ACTIVITIES:

1. Explain dwell.
2. Explain the need for breaker point gap.
3. Demonstrate setting breaker point gap.
4. Demonstrate use of dwell meter.
5. Explain internal and external dwell adjustments.

CRITERION REFERENCED MEASURE:

Practical Application:
Student will set breaker points using a dwell meter to meet manufacturer's specifications 100%.

Method of Evaluating Practical Application:
Use checklist for PO #37. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 37 EVALUATION

PERFORMANCE TEST FOR SETTING BREAKER POINT DWELL USING A DWELL METER

Student's Name **Date**

DIRECTIONS TO STUDENT: Set the breaker point dwell to 100% agreement with manufacturer's specifications. All items on checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Obtained specifications from operator's manual.		
2. Turned engine to obtain maximum breaker point opening.		
3. Checked breaker point spacing using feeler gauge.		
4. Adjusted spacing and alignment as needed.		
5. Checked adjustment and cleaned points.		
6. Attached dwell meter correctly.		
7. Checked dwell.		
8. Adjusted dwell to manufacturers specifications.		

APPROVED Yes ___ No ___

Evaluator's Signature Date

DUTY: MAINTAINING AND SERVICING THE IGNITION CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 38

TASK: Set ignition timing using a timing light.

STANDARD OF PERFORMANCE OF TASK:
Set the ignition timing on the tractor designated to 100% accuracy as specified in the operator's manual.

SOURCE OF STANDARD:
Tractor Maintenance, Southern Association for Agricultural Engineering and Vocational Agriculture.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a tractor that is out of time, operator's manual, a timing light and the necessary tools. Set the ignition timing.

ENABLING OBJECTIVE(S):

1. Know shop safety practice.
2. Ability to read.
3. Use of hand tools.

RESOURCES:

1. Operator's manual for timing light.
2. Service manual for tractor.

TEACHING ACTIVITIES:

1. Discuss shop safety.
2. Discuss ignition circuit.
3. Demonstrate use of timing light.
4. Demonstrate setting the timing.
5. Have students set timing.

CRITERION REFERENCED MEASURE:

Practical Application:
Set timing using a timing light.

Method of Evaluating Practical Application:
Using the checklist for PO #38. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 38 EVALUATION

PERFORMANCE TEST FOR SETTING IGNITION TIMING USING A TIMING LIGHT

Student's Name **Date**

DIRECTIONS TO STUDENT: Set the timing on a engine using the timing light. To 100% accuracy as specified in the operator's manual.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1.	Checked manual for specifications.		
2.	Located timing marks on flywheel or pulley.		
3.	Determined proper mark and rpm from manual.		
4.	Chalked timing mark.		
5.	Loosened distributor.		
6.	Set distributor properly.		
7.	Tightened distributor.		
8.	Rechecked timing.		
9.	Removed light.		

APPROVED Yes ____ No ____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING THE IGNITION CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 39

TASK: Test distributor advance mechanism.

STANDARD OF PERFORMANCE OF TASK:
Test the distributor advance mechanism on the designated tractor. The results should be within three degrees of the specifications in the operator's manual.

SOURCE OF STANDARD:
Kentucky Writing Team - Incumbent Worker.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a tractor with distributor having an advance mechanism, an operator's manual, a timing light with advance adjusting mechanism, and the necessary tools and equipment, test the distributor advance mechanism.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Use of hand tools.

RESOURCES:

1. Tractor Manufacturer's service manual.
2. Operating instructions for timing light.

TEACHING ACTIVITIES

1. Explain importance of distributor, its function and purpose.
2. Identify the parts of a distributor.
3. Explain how advance mechanisms work.
4. Demonstrate how to check advance mechanisms.
5. Demonstrate use of timing light.

CRITERION REFERENCED MEASURE

Practical Application:
Student will test distributor advance mechanism. The reading should be within $\pm 3^{\circ}$ of specifications.

Method of Evaluating Practical Application:
Use check for PO #39. All items will be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 39 EVALUATION

PERFORMANCE TEST FOR TESTING DISTRIBUTOR ADVANCE MECHANISM

Student's Name ______________________ **Date** ______________

DIRECTIONS TO STUDENT: Test distributor advance mechanism. Results must be within ± 3° of specifications and all items on checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1.	Checked operator's manual for initial timing, RPM at initial timing, RPM at mechanical advance, vacuum advance degrees, RPM at vacuum advance beginning, and high RPM total advance.	______	______
2.	Connected timing light according to manufacturer's specifications; disconnected and plugged vacuum advance.	______	______
3.	Started engine and adjusted engine RPM to low idle.	______	______
4.	Checked initial timing with timing light, and advanced the unit on the timing light; set at zero.	______	______
5.	Adjusted initial timing to correct specifications.	______	______
6.	Brought engine to RPM of full mechanical advance, rotated timing advance mechanism in timing light until original timing marks are together; read mechanical advance on timing light dial.	______	______
7.	Connected vacuum advance to distributor.	______	______
8.	Brought engine RPM to high idle.	______	______
9.	Rotated timing light advance dial until original marks are together.	______	______
10.	Read degrees of total advance on dial and compared with manufacturer's specifications. Read within 3° of specifications.	______	______

APPROVED Yes ___ No ___

Evaluator's Signature ______________________ Date ______________

DUTY: MAINTAINING AND SERVICING THE IGNITION CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 40

TASK: Test and replace ignition coil.

STANDARD OF PERFORMANCE OF TASK:
Test and replace the ignition coil on the designated tractor. Student reading on test indicator should be identical to instructor's reading.

SOURCE OF STANDARD:
Kentucky Writing Team - Incumbent Worker.

CONDITIONS FOR PERFORMANCE OF TASK:
Given an ignition coil, oscilloscope tester, and the necessary tools and equipment, test and replace the coil on the designated tractor.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Use of hand tools.

RESOURCES:

1. Manufacturer's Manual for tractor.
2. Operating instructions for oscilloscope.

TEACHING ACTIVITIES:

1. Discuss purpose and function of the coil.
2. Explain how to use oscilloscope.
3. Demonstrate use of oscilloscope to test ignition coil.
4. Demonstrate removal and replacement of coil.
5. Have students list steps followed in hooking up the oscilloscope.

CRITERION REFERENCED MEASURE:

Practical Application:
The student will test and replace coil as needed. All readings will agree with instructor's reading.

Method of Evaluating Practical Application:
Use checklist for PO #40. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 40 EVALUATION

PERFORMANCE TEST FOR TESTING AND REPLACING IGNITION COIL

Student's Name **Date**

DIRECTIONS TO STUDENT: Test and replace ignition coil. All reading must agree with instructor's and all steps on checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Removed wires from coil.		
2.	Connected suitable coil tester to input and output on coil.		
3.	Selected correct voltage on tester.		
4.	Rotated calibration knob to lowest level of power input.		
5.	Adjusted pattern length on the oscilloscope until one full wave length is displayed.		
6.	Rotated calibration knob until a reading of 20 KV is reached; if 20 KV reading is reached with full display pattern, the coil is serviceable.		
7.	Checked for reasons not reaching 20 KV reading such as shorted-open or reverse polarity.		
8.	If reverse polarity is noted, switched leads between plus (+) and minus (-) outlets on coil and rechecked.		
9.	If shorted-open problems are noted, replaced the coil.		
10.	Obtained the correct coil for the tractor and replaced the coil.		
11.	Rechecked to get readings that agree with instructor's.		

APPROVED Yes ___ No ___

Evaluator's Signature Date

DUTY: MAINTAINING AND SERVICING THE IGNITION CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 41

TASK: Test ignition distributor.

STANDARD OF PERFORMANCE OF TASK:
Check the condition of the distributor on the designated tractor. Evaluation will be based on successful completion of all points on a checklist.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a tractor with an ignition distributor and the necessary tools and equipment, check the condition of the distributor.

ENABLING OBJECTIVE:

1. Use of hand tools.

RESOURCES:

1. Tractor manufacturer's manual.

TEACHING ACTIVITIES

1. Explain the function and purpose of the distributor.
2. Explain how to calibrate a distributor.
3. Discuss the distribution calibration test.
4. Demonstrate the calibration test.
5. Have students perform calibration test.

CRITERION REFERENCED MEASURE:

Practical Application:
The student will check the condition of a distributor.

Method of Evaluating Practical Application:
Use checklist for PO# 41. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 41 EVALUATION

PERFORMANCE TEST FOR TESTING IGNITION DISTRIBUTOR

Student's Name **Date**

DIRECTIONS TO STUDENT: Check the condition of the distributor. All steps on the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Removed dirt from outside surface of distributor and cap.	____	____
2.	Cleaned inner surface.	____	____
3.	Identified defective cap (chips, breaks, cracks) and replaced.	____	____
4.	Cleaned rotor arm.	____	____
5.	Checked dust cover.	____	____

APPROVED Yes ___ No ___

Evaluator's Signature Date

MAINTAINING AND SERVICING THE COOLING SYSTEM

DUTY: MAINTAINING AND SERVICING THE COOLING SYSTEM

PERFORMANCE OBJECTIVE V-TECS 42

TASK: Flush and clean radiator.

STANDARD OF PERFORMANCE OF TASK:
Flush and clean the radiator on the designated tractor. The cleaned system should show no evidence of containing dirty coolant or foreign materials.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a water hose, appropriate tools, and a designated tractor, flush and clean the radiator system.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Knowledge of safety rules concerning hand tools and cooling systems.

RESOURCES:

1. **Fundamentals of Service — Engines,** pp. 8-1 thru 8-16.
2. Implement and Tractor Service Manual for specific tractors.

TEACHING ACTIVITIES:

1. Discuss with students the importance of a clean cooling system and its effects on engine performance.
2. Have students read **Fundamentals of Service — Engines,** Chapter 8.
3. Have students draw a simple cooling system, label the parts, and show the direction of coolant flow.
4. Demonstrate how to flush a radiator.
5. Assign students a tractor and have them flush the cooling system.

CRITERION REFERENCED MEASURE:

Practical Application:
Have student clean and flush a radiator using the steps in the performance checklist.

Method of Evaluating Practical Application:
Use instructor checklist for Performance Objective 42, all steps must be rated satisfactorily.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 42 EVALUATION

PERFORMANCE TEST FOR FLUSHING AND CLEANING RADIATOR

Student's Name **Date**

DIRECTIONS TO STUDENT: Clean and flush radiator on assigned tractor. All steps in the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Removed radiator cap.	______	______
2. Disconnected radiator hose.	______	______
3. Removed thermostat.	______	______
4. Rinstalled thermostat elbow.	______	______
5. Ran water and flushing solution through cooling system.	______	______
6. Ran clear water through the system.	______	______
7. Reinstalled thermostat.	______	______
8. Reinstalled radiator hose.	______	______
9. Cleaned radiator fins.	______	______
10. Refilled with coolant.	______	______
11. Cranked engine and checked for leaks.	______	______
12. Checked coolant level after engine has warmed up.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING THE COOLING SYSTEM

PERFORMANCE OBJECTIVE V-TECS 43

TASK: Replace cooling system thermostat.

STANDARD OF PERFORMANCE OF TASK:
Replace the cooling system thermostat on the designated engine. The new thermostat will be clean, installed according to directions in the service manual, and function to specifications.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a new thermostat and gasket, a service manual, and the necessary tools, replace the cooling system thermostat on an engine.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Knowledge of safety rules concerning hand tools and cooling systems.

RESOURCES:

1. **Fundamentals of Service -- Engines,** pp. 8-1 thru 8-16.
2. Implement and Tractor Service Manual for specific tractor.

TEACHING ACTIVITIES:

1. Discuss with students what the thermostat does and why it is important to have one in an engine.
2. Have students read **Fundamentals of Service -- Engines,** Chapter 8, pp. 1- 16.
3. Demonstrate to students how a thermostat works.
4. Pass around to class several examples of thermostats.
5. Show students how to replace a thermostat.
6. Assign students to an engine and have them replace thermostat.

CRITERION REFERENCED MEASURE:

Practical Application:
Have student replace thermostat using the steps in the performance guide.

Method of Evaluating Practical Application:
Use instructor checklist for Performance Objective 43, all steps must be rated satisfactorily.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 43 EVALUATION

PERFORMANCE TEST FOR REPLACING COOLING SYSTEM THERMOSTAT

Student's Name **Date**

DIRECTIONS TO STUDENT: Replace cooling system thermostat on assigned tractor. All steps in performance guide must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Cleaned area around thermostat.	____________	____________
2.	Removed the thermostat.	____________	____________
3.	Cleaned gasket surface thoroughly.	____________	____________
4.	Installed new thermostat.	____________	____________
5.	Be sure it's installed with bellows toward engine.	____________	____________
6.	Installed new gasket and gasket sealer.	____________	____________
7.	Cranked engine and checked for leaks.	____________	____________

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING THE COOLING SYSTEM

PERFORMANCE OBJECTIVE V-TECS 44

TASK: Replace radiator hose.

STANDARD OF PERFORMANCE OF TASK:
Replace radiator hose on the designated tractor. The new hose should show no visible signs of leaks.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a screwdriver, hose-clamp pliers, and scraper, replace the radiator hose on the designated tractor.

ENABLING OBJECTIVE(S):

1. Knowledge of safety rules concerning hand tools and cooling systems.
2. Ability to read.

RESOURCES:

1. **Fundamentals of Service -- Engine,** pp. 8-1 thru 8-16.

TEACHING ACTIVITIES:

1. Discuss with students the importance of keeping cooling system hoses in good condition.
2. Have students read **FOS — Engines,** Chapter 8, pp. 1-16.
3. Show students examples of radiation hose that appear good on the outside, but are bad inside.
4. Show them several types of hose clamps.
5. Demonstrate use of hose clamp pliers.
6. Have students replace radiator hose on engine assigned to them.

CRITERION REFERENCED MEASURE:

Practical Application:
Have student replace a radiator hose following the steps in the performance checklist.

Method of Evaluating Practical Application:
Use instructor checklist for Performance Objective 44, all steps must be rated satisfactorily.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 44 EVALUATION

PERFORMANCE TEST FOR REPLACING RADIATOR HOSES

Student's Name **Date**

DIRECTIONS TO STUDENT: Replace radiator hoses on assigned tractor. All steps in the performance checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Drained cooling system.		
2.	Removed old hose (Be careful, radiator neck is fragile).		
3.	Cleaned radiator neck and engine outlet fixtures.		
4.	Installed new radiator hose.		
5.	Refilled cooling system.		
6.	Checked for leaks.		
7.	Checked coolant level after engine has warmed up.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING THE COOLING SYSTEM

PERFORMANCE OBJECTIVE V-TECS 45

TASK: Replace water pump.

STANDARD OF PERFORMANCE OF TASK:
Replace the water pump on the designated tractor. The replaced water pump should show no signs of leakage and all steps in the installation process should be completed according to an instructor checklist.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a socket set, open-end and box-end wrench set, screwdrivers, clamp pliers, and gasket sealing compound, replace water pump.

ENABLING OBJECTIVE(S):

1. Knowledge of safety rules concerning hand tools and cooling system.
2. Ability to read.
3. Use of hand tools.

RESOURCES:

1. **Fundamentals of Service -- Engines,** pp. 8-1 thru 8-16.
2. Implement and Service Manual for specific tractor.

TEACHING ACTIVITIES:

1. Discuss with students what a defective water pump can do to an engine.
2. Have students read **FOS -- Engines,** Chapter 8, pp. 1-16.
3. Demonstrate how to replace water pump.
4. Have students find the procedure for a specific tractor in I and T Service Manual and write it out.
5. Assign student to an engine and have them replace water pump..

CRITERION REFERENCED MEASURE:

Practical Application:
Have students replace water pump following the steps in the performance guide.

Method of Evaluating Practical Application:
Use instructor checklist for Performance Objective 45, all steps must be rated to be satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 45 EVALUATION

PERFORMANCE TEST FOR REPLACING WATER PUMP

Student's Name ______________________________ Date __________

DIRECTIONS TO STUDENT: Replace water pump on assigned tractor. All steps in the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Drained cooling system.		
2.	Removed water pump.		
3.	Cleaned gasket surface.		
4.	Installed new gasket and gasket material.		
5.	Installed new water pump.		
6.	Adjusted belt drives.		
7.	Filled cooling system.		
8.	Cranked engine and checked for leaks.		
9.	Checked belt tension.		
10.	Checked coolant level after engine warmed up.		

APPROVED: Yes _____ No _____

Evaluator's Signature ______________________________ Date __________

DUTY: MAINTAINING AND SERVICING THE COOLING SYSTEM

PERFORMANCE OBJECTIVE V-TECS 46

TASK: Service fanbelts.

STANDARD OF PERFORMANCE OF TASK:
Replace fanbelt on the designated tractor and adjust tension to manufacturer's specifications.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a new fanbelt, service manual, open-end wrenches, and belt tension gauge, replace the belt on the designated tractor.

ENABLING OBJECTIVE(S):

1. Knowledge of safety practices concerning hand tools and cooling system safety.
2. Ability to read.
3. Use of hand tools.

RESOURCES:

1. **Fundamentals of Service — Engines,** pp. 8-1 thru 8-16.
2. I and T Service Manual for specific tractor.

TEACHING ACTIVITIES:

1. Discuss with students the reasons for keeping belts in good condition.
2. Have student read **FOS — Engines,** Chapter 8, pp. 1-16.
3. Show student how to replace belts and put correct tension on them.
4. Demonstrate the proper method for putting correct tension on the belt.
5. Have them look up correct tension in I and T Service Manual for specific tractor.
6. Assign students an engine and have them service fan belts.

CRITERION REFERENCED MEASURE:

Practical Application:
Have students service fanbelts following the steps in the checklist.

Method of Evaluating Practical Application:
Use instructor checklist for Performance Objective 46, all items must be rated satisfactorily.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 46 EVALUATION

PERFORMANCE TEST FOR SERVICING FAN BELTS

Student's Name **Date**

DIRECTIONS TO STUDENT: Replace fan belts on assigned tractor. All steps in the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Removed old fan belt.	________	________
2. Checked pulleys for wear or burrs.	________	________
3. Installed new belt.	________	________
4. Checked alignment.	________	________
5. Checked belt tension.	________	________
6. Cranked engine and rechecked tension.	________	________

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING THE COOLING SYSTEM

PERFORMANCE OBJECTIVE V-TECS 47

TASK: Test cooling system for leaks.

STANDARD OF PERFORMANCE OF TASK:
Test the cooling system on the designated tractor for leaks. All cooling system leaks should be identified.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Using the designated tractor and a pressure tester, test the cooling system for leaks.

ENABLING OBJECTIVE(S):

1. Knowledge of safety rules concerning hand tools and cooling system safety rules.
2. Ability to read.

RESOURCES:

1. **Fundamentals of Service -- Engines,** pp. 8-1 thru 8-16.
2. Instruction booklet with pressure tester.

TEACHING ACTIVITIES:

1. Explain to students how to trouble shoot the cooling system.
2. Have student read **FOS — Engines,** Chapter 8, pp. 1-16.
3. Hand out a copy of instruction sheet that came with pressure tester and review with students.
4. Demonstrate how to test a cooling system for leaks.
5. Assign students an engine and have them check the cooling system for leaks.

CRITERION REFERENCED MEASURE:

Practical Application:
Have students test cooling system for leaks following the steps in the checklist.

Method of Evaluating Practical Application:
Use instruction checklist for Performance Objective 47, all steps must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 47 EVALUATION

PERFORMANCE TEST FOR TESTING COOLING SYSTEM FOR LEAKS

Student's Name **Date**

DIRECTIONS TO STUDENT: Test cooling system for leaks on assigned tractor. All steps in the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needs, supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Installed pressure tester.	____________	____________
2. Didn't apply to much pressure.	____________	____________
3. Checked for leaks under pressure.	____________	____________
4. Repaired leaks.	____________	____________
5. Checked under pressure again.	____________	____________

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING THE COOLING SYSTEM

PERFORMANCE OBJECTIVE V-TECS 48

TASK: Test radiator coolant.

STANDARD OF PERFORMANCE OF TASK:
Test the radiator coolant in the designated tractor. The reading should be within one gradation of the instructor's reading on the hydrometer scale.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a designated tractor and a hydrometer, test the radiator coolant supply.

ENABLING OBJECTIVE(S):

1. Knowledge of safety rules concerning hand tools and cooling system safety rules.
2. Ability to read.

RESOURCES:

1. **Fundamentals of Service -- Engines,** pp. 8-1 thru 8-16.
2. Tractor Operators Manual.

TEACHING ACTIVITIES:

1. Discuss with students how the lack of coolant (antifreeze) can cause engine damage.
2. Have student read **FOS — Engines,** Chapter 8, pp. 1-16.
3. Demonstrate to students how to read a hydrometer.
4. Demonstrate how to test coolant in a radiator.
5. Assign students an engine and have them test the coolant in a radiator.

CRITERION REFERENCED MEASURE:

Practical Application:
Have students test radiator coolant following the steps in the checklist.

Method of Evaluating Practical Application:
Use instructor checklist for Performance Objective 48, all steps must be rated satisfactorily.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 48 EVALUATION

PERFORMANCE TEST FOR TESTING RADIATOR COOLANT

Student's Name **Date**

DIRECTIONS TO STUDENT: Test radiator coolant on assigned tractor. All steps in the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Inserted hydrometer and drew enough coolant to get a reading.	____	____
2. Made sure float didn't stick in hydrometer.	____	____
3. Recorded reading.	____	____
4. Flushed hydrometer with clean water.	____	____

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING THE COOLING SYSTEM

PERFORMANCE OBJECTIVE V-TECS 49

TASK: Test radiator pressure caps.

STANDARD OF PERFORMANCE OF TASK:
Test the radiator cap on the designated tractor for correct pressure tolerance. The gauge reading should be within one gradation of the instructor's reading.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Using the designated tractor, a pressure tester, and an adapter, test the radiator cap for pressure tolerance.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Knowledge of safety rules concerning hand tools and cooling systems.

RESOURCES:

1. **Fundamentals of Service — Engines,** pp. 8-1 thru 8-16.
2. I and T Service Manual for specific tractor.

TEACHING ACTIVITIES:

1. Explain to students how a pressure cap operates.
2. Have students read **FOS -- Engines,** Chapter 8, pp. 1-16.
3. Show and discuss examples of types of radiator caps.
4. Demonstrate how to use radiator cap tester.
5. Demonstrate how to test a radiator cap.
6. Have students test radiator cap.

CRITERION REFERENCED MEASURE:

Practical Application:
Have students test a radiator cap using the steps in the checklist.

Method of Evaluating Practical Application:
Use instructor checklist for Performance Objective 49, all steps must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 49 EVALUATION

PERFORMANCE TEST FOR TESTING RADIATOR PRESSURE CAP

Student's Name _______________ **Date** _______

DIRECTIONS TO STUDENT: Test pressure cap on assigned tractor. All steps in checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Installed tester on cap.	______	______
2. Pumped up tester until cap releases.	______	______
3. Recorded reading.	______	______
4. Compared reading with specifications on cap.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature _______________ **Date** _______

DUTY: MAINTAINING AND SERVICING THE COOLING SYSTEM

PERFORMANCE OBJECTIVE V-TECS 50

TASK: Test thermostat.

STANDARD OF PERFORMANCE OF TASK:
Test the thermostat on the designated tractor. The thermometer reading, when the valve opens, should agree with the instructor's reading within plus or minus ±3°F.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Using a thermometer, a container of antifreeze solution, a .003" feeler gauge, and the proper tools, test the thermostat on the designated tractor.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Knowledge of safety practices concerning heating water.
3. Ability to read a thermometer and feeler gauge.

RESOURCES:

1. **Fundamentals of Service -- Engines,** pp. 8-1 thru 8-16.
2. I and T service manual for specific tractor.

TEACHING ACTIVITIES:

1. Explain to students the importance of an engine operating temperature (approximately 180°F).
2. Have them read **FOS -- Engines,** Chapter 8, pp. 1-16.
3. Demonstrate to student how to test a thermostat.
4. Discuss with the students how to troubleshoot thermostat problems.
5. Show students how long it takes an engine to warm up not using a thermostat.

CRITERION REFERENCED MEASURE:

Practical Application:
Have students test a thermostat using the steps in the performance guide.

Method of Evaluating Practical Application:
Use instructor checklist for Performance Objective 50, all steps must be rated satisfactorily.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 50 EVALUATION

PERFORMANCE TEST FOR TESTING THERMOSTAT

Student's Name **Date**

DIRECTIONS TO STUDENT: Test thermostat on assigned tractor. All steps in the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Removed thermostat.		
2. Heated thermostat in an antifreeze solution.		
3. Checked to see at what temperature it opens.		
4. Reinstalled thermostat.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

MAINTAINING AND SERVICING THE CHARGING CIRCUIT

DUTY: MAINTAINING AND SERVICING THE CHARGING CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 51

TASK: Adjust voltage regulator.

STANDARD OF PERFORMANCE OF TASK:
Using the fixed resistance method, adjust the voltage regulator on the designated tractor. Adjustments should meet specifications in the service manual.

SOURCE OF STANDARD:
Fundamentals of Service — Electrical Systems, Deere and Company, Moline, ILL., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Given necessary tools, voltage regulator, one-fourth ohm fixed resistor, voltmeter, and technical service manual, adjust the voltage regulator using the fixed resistance method.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Use of hand tools.

RESOURCES:

1. Shop manual for equipment.
2. **Fundamentals of Service — Electrical Systems,** pp. 4-19 thru 4-30.

TEACHING ACTIVITIES:

1. Discuss reasons for proper regulator adjustment.
2. Read and discuss **Fundamentals of Service: Electrical Systems,** Chapter 4, pp. 4-19 -- 4-30.
3. Demonstrate how to adjust a voltage regulator.
4. Have students describe how to adjust a voltage regulator.
5. Have students adjust voltage regulator.

CRITERION REFERENCED MEASURE:

Practical Application:
Given necessary tools, equipment, and service manual, adjust the voltage regulator using the fixed resistance methods.

Method of Evaluating Practical Application:
Using the checklist for Performance Objective 51, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 51 EVALUATION

PERFORMANCE TEST FOR ADJUSTING VOLTAGE REGULATOR

Student's Name **Date**

DIRECTIONS TO STUDENT: Given necessary tools, voltage regulator, one fourth ohm fixed resistor, voltmeter, and technical service manual, adjust the voltage regulator using the fixed resistance method.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1.	Read technical manual.		
2.	Inserted a one-fourth ohm fixed resistor into the charging circuit at battery terminal.		
3.	Connected voltmeter from battery terminal to ground.		
4.	Cycled the generator.		
5.	Adjusted voltage setting.		
6.	Replaced cover and cycled the generator.		
7.	Took a reading.		

APPROVED: Yes _____ No _____

Evaluator's Name **Date**

DUTY: MAINTAINING AND SERVICING THE CHARGING CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 52

TASK: Adjust voltage regulator.

STANDARD OF PERFORMANCE OF TASK:
Using the variable-resistance method, adjust the voltage regulator on the designated tractor. Adjustments should meet specifications in the technical service manual.

SOURCE OF STANDARD:
Fundamentals of Service -- Electrical Systems, Deere and Company, Moline, ILL., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Given necessary tools, voltage regulator, voltmeter, and technical service manual, adjust the voltage regulator using the variable-resistance method.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Use of hand tools.

RESOURCES:

1. Shop manual for equipment.
2. **Fundamentals of Service — Electrical System,** pp. 4-19 thru 4-30.

TEACHING ACTIVITIES:

1. Discuss the reason for proper voltage regulator adjustment.
2. Have students read and discuss with them **Fundamentals of Service - Electrical Systems,** Chapter 4, pp. 4-19 -- 4.30.
3. Demonstrate the variable resistance method of adjusting a voltage regulator.
4. Have the student describe the variable resistance method of adjusting a voltage regulator.
5. Have student perform the task of adjusting a voltage regulator using the variable resistance method.

CRITERION REFERENCED MEASURE:

Practical Application:
Given necessary tools, equipment, and service manual, adjust a voltage regulator using the variable resistance method.

Method of Evaluating Practical Application:
Using checklist for Performance Objective 52, all items must be satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 52 EVALUATION

PERFORMANCE TEST FOR ADJUSTING VOLTAGE REGULATOR

Student's Name **Date**

DIRECTIONS TO STUDENT: Given necessary tools, voltage regulator, voltmeter, and technical service manual, adjust the voltage regulator using the variable-resistance method.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Read technical manual.		
2.	Connected a variable resistor and an ammeter into the charging circuit at the battery terminal.		
3.	Started generator and adjusted resistor to get current flow of not more than 10 amperes.		
4.	Cycled the generator.		
5.	Adjusted the voltage setting.		
6.	Reinstalled cover and cycled the generator.		
7.	Took a reading.		

APPROVED: Yes _____ No _____

Evaluator's Name **Date**

DUTY: MAINTAINING AND SERVICING THE CHARGING CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 53

TASK: Check armature and fields.

STANDARD OF PERFORMANCE OF TASK:
Check the armature and field in the generator in a designated tractor. The readings on test equipment should be 100 percent accurate when compared to those of the instructor.

SOURCE OF STANDARD:
Fundamentals of Service -- Electrical Systems, Deere and Company, Moline, ILL., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Given proper test lamp, growler, combination test unit, necessary tools and equipment, check the armature and field.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Use of hand tools.

RESOURCES:

1. Shop manual for equipment.
2. **Fundamentals of Service -- Electrical Systems,** pp. 4-1 thru 4-17.

TEACHING ACTIVITIES:

1. Explain the different tests that can be done on a armature.
2. Discuss the possible failures of the armature.
3. Demonstrate the proper way to test the armature and field.
4. Have student list the steps used to check an armature and field.
5. Have student perform the task of checking armature and fields.

CRITERION REFERENCED MEASURE:

Practical Application:
Given proper test lamp, growler, combination test unit, necessary tools and equipment, check the armature and field.

Method of Evaluating Practical Application:
Using the checklist for Performance Objective 53, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 53 EVALUATION

PERFORMANCE TEST FOR CHECKING ARMATURE AND FIELD

Student's Name **Date**

DIRECTIONS TO STUDENT: Given necessary tool and equipment, check the armature and field in the generator in a designated tractor. The readings on the test equipment should be 100 percent accurate when compared to those of the instructor.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Visually inspected the armature for an open circuit.	________	________
2. Tested for an open circuit using combination test unit and growler.	________	________
3. Performed test for shorted armature and grounded armature.	________	________
4. Tested for open field circuit.	________	________
5. Tested for grounded field circuit or shorted field circuit.	________	________

APPROVED: Yes _____ No _____

Evaluator's Name **Date**

DUTY: MAINTAINING AND SERVICING THE CHARGING CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 54

TASK: Polarize a tractor generator.

STANDARD OF PERFORMANCE OF TASK:

Using ignition tools, polarize the tractor generator on the designated tractor.

SOURCE OF STANDARD:

Tractor Maintenance, Southern Association for Agricultural Engineering and Vocational Agriculture.

CONDITIONS FOR PERFORMANCE OF TASK:

Given ignition tools and a tractor with a generator in need of polarization, polarize the generator.

ENABLING OBJECTIVE(S):

1. Use of hand tools.
2. Ability to read.

RESOURCES:

1. Shop manual for equipment.
2. **Fundamentals of Service -- Electrical Systems,** p. 8-3.

TEACHING ACTIVITIES:

1. Explain what can happen if the generator is not polarized.
2. Discuss the proper way to polarize a generator.
3. Have student to describe how to polarize a generator.
4. Demonstrate the proper way to polarize a generator.
5. Have student polarize a generator.

CRITERION REFERENCED MEASURE:

Practical Application:

Using the manufacturer's service manual, the recommended tools and equipment, polarize the tractor generator on the designated tractor.

Method of Evaluating Practical Application:

Polarizing of the generator will be in the order specified in the service manual and the generator must work correctly.

PERFORMANCE GUIDE:

1. Polarize the generator on externally grounded generators by touching a short insulated jumper wire momentarily between the two posts on the regulator marked "Bat" and "Gen" (sometimes marked "Arm").
2. Polarize the generator on internally grounded generator by momentarily touching the ends of the "Bat" wire and the "FLD" wire together.

DUTY: MAINTAINING AND SERVICING THE CHARGING CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 55

TASK: Test a tractor generator on a bench using the test for the common A circuit generator.

STANDARD OF PERFORMANCE OF TASK:
On the designated tractor, test the generator on a bench using the test for common A-circuit generators. The voltmeter and ammeter readings should be 100 percent accurate when compared to those of the instructor.

SOURCE OF STANDARD:
Fundamentals of Service — Electrical Systems, Deere and Company, Moline, ILL., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Given an ammeter, carbon-pile resistor, voltmeter, switch and necessary tools, test the generator on the bench to determine output.

ENABLING OBJECTIVE(S):
1. Use of hand tools.
2. Ability to read.

RESOURCES:
1. Manufacturer's service manual for equipment.
2. **Fundamentals of Service -- Electrical Systems,** pp. 4-12 thru 4-19.

TEACHING ACTIVITIES:
1. Discuss reasons for bench testing a tractor generator.
2. Explain how to use the voltmeter and ammeter.
3. Demonstrate the proper way to test a tractor generator on a bench using the test for the common A circuit generator.
4. Have the student to list the steps in testing the A circuit generator.
5. Have the student perform the task of testing the common A circuit generator.

CRITERION REFERENCED MEASURE:

Practical Application:
Given an ammeter, carbon pile resistor, voltmeter switch, and necessary tools, test the generator on the bench to determine output.

Method of Evaluating Practical Application:
The voltmeter and ammeter reading must be 100 percent accurate when compared to those of the instructor.

PERFORMANCE GUIDE:

1. Consult the manufacturer's technical service manual for service and repair specifications.
2. Connect an ammeter and switch in series with a battery to the generator output terminal.
3. Connect a voltmeter from the generator output to ground.
4. Connect a carbon pile resistor across the battery.
5. Connect a jumper lead to the generator field terminal.
6. Operate the generator to obtain battery voltage and close the switch.
7. Speed up the generator to its rated value, adjust the carbon pile to obtain the specified voltage and compare the current output with the generator specifications.
8. If the generator output is below par, check for additional malfunctions.

DUTY: MAINTAINING AND SERVICING THE CHARGING CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 56

TASK: Replace amperage gauge.

STANDARD OF PERFORMANCE OF TASK:
Replace the amperage gauge on the designated tractor. The replaced gauge should function properly and all the steps on an instructor's checklist should be completed during the replacement process.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given replacement amperage gauge, necessary tools and equipment, replace an amperage gauge on the designated tractor.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Use of hand tools.

RESOURCES:

1. Shop manual for equipment.

TEACHING ACTIVITIES:

1. Explain the function of an amperage gauge.
2. Discuss the steps in replacing an amperage gauge.
3. Show the student how an amperage gauge is connected.
4. Have the student list the steps in replacing an amperage gauge.
5. Have student replace an amperage gauge.

CRITERION REFERENCED MEASURE:

Practical Application:
Given replacement amperage gauge, necessary tools and equipment, replace an amperage gauge on a designated tractor.

Method of Evaluating Practical Application:
Using the checklist for Performance Objective 56, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 56 EVALUATION

PERFORMANCE TEST FOR REPLACING AMPERAGE GAUGE

Student's Name **Date**

DIRECTIONS TO STUDENT: Replace amperage gauge. The replaced gauge must function properly and all steps on the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Secured correct amperage gauge.		
2. Removed amperage gauge.		
3. Removed wires.		
4. Installed new wires.		
5. Mounted amperage gauge.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING THE CHARGING CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 57

TASK: Replace bearings (alternator or generator).

STANDARD OF PERFORMANCE OF TASK:
Replace the bearings in the designated alternator or generator. When service is complete the armature will run free with no side play.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a new set of bearings, a service manual, a mechanic's tool set, and an arbor press, replace the bearings in an alternator or generator.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Use of hand tools.

RESOURCES:

1. Shop manual for equipment.

TEACHING ACTIVITIES:

1. Explain how to identify defective bearings.
2. Discuss reasons for replacing bearing on a alternator or generator.
3. Demonstrate the proper steps in replacing bearing on a alternator or generator.
4. Review the steps in replacing bearings.
5. Have student replace the bearing on an alternator or a generator.

CRITERION REFERENCED MEASURE:

Practical Application:
Given the necessary tools, equipment, and service manual, replace the bearings in the designated alternator or generator.

Method of Evaluating Practical Application:
Disassembly and reassembly will be in the order specified in the service manual. When service is completed the armature will run free with no side play.

PERFORMANCE GUIDE:

1. Identify defective bearing based on the side play in the armature.
2. Disassemble alternator or generator following instructions in the manufacturer's service manual.
3. Press defective bearing from housing.
4. Press new bearing into housing.
5. Reassemble alternator or generator.

DUTY: MAINTAINING AND SERVICING THE CHARGING CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 58

TASK: Replace diodes.

STANDARD OF PERFORMANCE OF TASK:
Replace a diode on the designated alternator. The replacement process should include the completion of all the steps on an instructor checklist.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given an appropriate press, an alternator, soldering iron, pliers, and necessary tools, replace a diode.

ENABLING OBJECTIVE(S):
1. Ability to read.
2. Use of hand tools.

RESOURCES:
1. Manufacturer's service manual.

TEACHING ACTIVITIES:
1. Explain the purpose of the diode.
2. Discuss the steps in testing the diode.
3. Demonstrate the proper method of testing the diode.
4. Demonstrate the proper way of replacing a diode.
5. Have student list steps in replacing a diode.
6. Have student replace a diode.

CRITERION REFERENCED MEASURE:

Practical Application:
Given an appropriate press, an alternator, soldering iron, pliers, and necessary tools, replace a diode.

Method of Evaluating Practical Application:
Using the checklist for Performing Objective 58, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 58 EVALUATION

PERFORMANCE TEST FOR REPLACING DIODES

Student's Name **Date**

DIRECTIONS TO STUDENT: Replace diode. All steps on the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Located defective diode.	______	______
2. Unsoldered diode leads.	______	______
3. Pressed out diode.	______	______
4. Installed new diode.	______	______
5. Soldered leads.	______	______
6. Checked diode for proper function.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING THE CHARGING CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 59

TASK: Replace generator brushes.

STANDARD OF PERFORMANCE OF TASK:
Change the generator brushes on the designated tractor. The replacement process should include the successful completion of all the steps on an instructor checklist.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Using new brushes, necessary tools and equipment, replace the brushes on the designated generator.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Use of hand tools.

RESOURCES:

1. Manufacturer's service manual for equipment.
2. **Fundamentals of Service — Electrical Systems,** pp. 4-5.

TEACHING ACTIVITIES:

1. Explain the function of the generator brushes.
2. Discuss how to identify brushes that need replacing.
3. List the steps in replacing generator brushes.
4. Demonstrate the proper way to replace generator brushes.
5. Have student replace generator brushes.

CRITERION REFERENCED MEASURE:

Practical Application:
Given the necessary tools and equipment, replace the brushes on a designated generator.

Method of Evaluating Practical Application:
Using the checklist for Performance Objective 59, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 59 EVALUATION

PERFORMANCE TEST FOR REPLACING GENERATOR BRUSHES

Student's Name **Date**

DIRECTIONS TO STUDENT: Change the generator brushes. All steps on the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Cleaned generator housing.	______	______
2. Removed band cover.	______	______
3. Removed brush tension clip.	______	______
4. Installed new brushes.	______	______
5. Polarized generator.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING THE CHARGING CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 60

TASK: Replace heat sink.

STANDARD OF PERFORMANCE OF TASK:
Replace the heat sink on the designated alternator. The diodes should function correctly based on an alternator diode test. The heat sink will be in position as designated by the specific alternator.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a charging system with a faulty heat sink, a new heat sink, service manual, the needed wrenches, alternator and soldering iron, replace the heat sink.

ENABLING OBJECTIVE(S):
1. Ability to read.
2. Use of hand tools.

RESOURCES:
1. Manufacturer's service manual.
2. **Fundamentals of Service — Electrical Systems,** pp. 4-41.

TEACHING ACTIVITIES:
1. Discuss the function of the heat sink.
2. Explain the steps in replacing a heat sink.
3. Have the student list the steps in replacing a heat sink.
4. Demonstrate the proper way to replace a heat sink.
5. Have the student perform the task of replacing a heat sink.

CRITERION REFERENCED MEASURE:

Practical Application:
Given the necessary tools and equipment replace a heat sink on a designated alternator.

Method of Evaluating Practical Application:
Using the checklist for Performance Objective 60, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 60 EVALUATION

PERFORMANCE TEST FOR REPLACING HEAT SINK

____

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a new heat sink, service manual, necessary tools and equipment, replace a heat sink on a designated alternator. The replacement process includes the completion of all the steps on the instructor's checklist.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1.	Checked manufacturer's service manual.	________	________
2.	Unsoldered leads from diodes to stator windings.	________	________
3.	Unbolted heat sink assembly.	________	________
4.	Bolted new assembly in place.	________	________
5.	Soldered leads from the diode to the stator winding.	________	________
6.	Reassemble all parts removed.	________	________

APPROVED: Yes _____ No _____

____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING THE CHARGING CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 61

TASK: Service the alternator regulator.

STANDARD OF PERFORMANCE OF TASK:
Service the alternator regulator on the designated tractor. The results of service and adjustments should be 100 percent accurate as indicated in the service manual.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given necessary tools, equipment, and service manual, test the alternator regulator.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Use of hand tools.

RESOURCES:

1. Manufacturer's service manual.
2. **Fundamentals of Service -- Electrical Systems,** pp. 4-6.

TEACHING ACTIVITIES:

1. Discuss the importance of servicing the alternator regulator.
2. Explain how to service the alternator regulator.
3. Have the student list the steps in servicing the alternator regulator.
4. Demonstrate the proper way to service the alternator regulator.
5. Have student perform the task of servicing the alternator regulator.

CRITERION REFERENCED MEASURE:

Practical Application:
Given the necessary tools and equipment, service the alternator regulator.

Method of Evaluating Practical Application:
Using the checklist for Performance Objective 61, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 61 EVALUATION

PERFORMANCE TEST FOR SERVICING THE ALTERNATOR REGULATOR

Student's Name **Date**

DIRECTIONS TO STUDENT:	Given the necessary tools, equipment, and service manual, test an alternator regulator.
DIRECTIONS TO EVALUATOR:	Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1.	Referred to the service manual.	______	______
2.	Turned the adjusting screw to the desired output.	______	______
3.	Tested charging circuit with a voltmeter, ammeter, and low carbon pile.	______	______
4.	Replaced regulator (if needed).	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING THE CHARGING CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 62

TASK: Test alternator diodes.

STANDARD OF PERFORMANCE OF TASK:
Test the diode in the alternator on the designated tractor. The reading on the ohmmeter should be 100 percent accurate when compared to the reading obtained by the instructor.

SOURCE OF STANDARD:
Fundamentals of Service -- Electrical Systems, Deere and Company, Moline, ILL., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a 1½ ohm ohmmeter and necessary tools and equipment, test the alternator diode.

ENABLING OBJECTIVE(S):
1. Ability to read.
2. Use of hand tools.

RESOURCES:
1. **Fundamentals of Service -- Electrical Systems,** pp. 2-8, 4-45 thru 4-47.

TEACHING ACTIVITIES:
1. Explain the purpose of the diodes.
2. Describe the proper way to test alternator diodes.
3. Have student list the steps in testing diodes.
4. Demonstrate the proper way to test alternator diodes.
5. Have student test alternator diodes.

CRITERION REFERENCED MEASURE:

Practical Application:
Given a 1½ ohm ohmmeter and the necessary tools and equipment, test the alternator diode.

Method of Evaluating Practical Application:
The reading on the ohmmeter should be 100 percent accurate when compared to the reading obtained by the instructor.

PERFORMANCE GUIDE:
1. Connect one ohmmeter lead to the diode case and the other ohmmeter lead to the diode lead.
2. Note the ohmmeter reading.
3. Reverse the ohmmeter leads and note the reading. A good diode will give a high and low reading. If only a slight difference in reading is noted from one diode lead to the other diode lead, the diode is probably defective.

DUTY: MAINTAINING AND SERVICING THE CHARGING CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 63

TASK: Test charging circuit using a voltmeter, ammeter, and/or carbon pile.

STANDARD OF PERFORMANCE OF TASK:
Test the charging circuit on the designated tractor. The readings on the test equipment should be 100 percent accurate when compared to that of the instructor.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a voltmeter, ammeter, carbon-pile resistor, and necessary tools, test the charging circuit.

ENABLING OBJECTIVE(S):

1. Ability to read.

RESOURCES:

1. **Fundamentals of Service -- Electrical System,** pp. 4-59 thru 4-61.

TEACHING ACTIVITIES:

1. Discuss the reasons for testing the charging circuits.
2. Demonstrate how to use a voltmeter, ammeter, and carbon pile.
3. Demonstrate the steps in testing a charging circuit.
4. Have student list the steps in testing a charging circuit.
5. Have student test charging circuit using a voltmeter, ammeter, and carbon pile.

CRITERION REFERENCED MEASURE:

Practical Application:
Given a voltmeter, ammeter, carbon-pile resistor, and necessary tools, test the charging circuit on a designated tractor.

Method of Evaluating Practical Application:
Using the checklist for Performance Objective 63, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 63 EVALUATION

PERFORMANCE TEST FOR CHARGING CIRCUIT USING A VOLTMETER, AMMETER, AND CARBON PILE

Student's Name **Date**

DIRECTIONS TO STUDENT:	Given a voltmeter, ammeter, carbon pile resistor, and necessary tools, test the charging circuit on a designated tractor.
DIRECTIONS TO EVALUATOR:	Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Referred to technical manual.	______	______
2. Set-up test circuit.	______	______
3. Connected voltmeter to the alternator ground and output terminal.	______	______
4. Started engine and inserted a load of about 10 amp.	______	______
5. Operated the circuit to stabilize the regulator temperature.	______	______
6. Compared the voltmeter reading with voltage specifications.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING THE CHARGING CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 64

TASK: Turn armature.

STANDARD OF PERFORMANCE OF TASK:
Turn the armature on the designated generator. The micrometer reading should be equal to the reading obtained by the instructor.

SOURCE OF STANDARD:
Fundamentals of Service — Electrical Systems, Deere and Company, Moline, ILL., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Given an armature turning tool, micrometer, and other necessary tools, turn an armature.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Use of hand tools.

RESOURCES:

1. **Fundamentals of Service — Electrical Systems,** pp. 4-15.

TEACHING ACTIVITIES:

1. Explain reasons for turning armature.
2. Describe the proper way to turn armature.
3. Demonstrate the steps in turning an armature.
4. Have student list steps in turning an armature.
5. Have student turn armature.

CRITERION REFERENCED MEASURE:

Practical Application:
Given an armature turning tool, micrometer, and other necessary tools, turn an armature on a designated tractor.

Method of Evaluating Practical Application:
Using the checklist for Performance Objective 64, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 64 EVALUATION

PERFORMANCE TEST FOR TURNING ARMATURE

Student's Name **Date**

DIRECTIONS TO STUDENT: Given an armature tool, micrometer, and other necessary tools, turn an armature on a designated generator.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Fastened the armature in tool for turning down armature.	____	____
2. Turned the armature until smooth and round.	____	____
3. Checked for roundness with a micrometer.	____	____
4. Tested armature for grounds, shorts, and balance.	____	____

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

MAINTAINING AND SERVICING THE STARTING CIRCUIT

DUTY: MAINTAINING AND SERVICING THE STARTING CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 65

TASK: Check armature and fields.

STANDARD OF PERFORMANCE OF TASK:
Check the armature and fields of the starter on the designated tractor. All checking procedures on an instructor's checklist will be completed.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK: Using a mechanic's tool set, an armature tester (growler), a continuity tester voltmeter, ammeter and tachometer (speed indicator), check the armature and fields of the starter on the designated tractor.

ENABLING OBJECTIVE(S):

1. Know safety precautions.
2. Ability to read.
3. Use of hand tools.

RESOURCES:

1. **Fundamentals of Service - Electrical Systems,** pp. 4-5 through 4-17.
2. Equipment service manual.

TEACHING ACTIVITIES:

1. Discuss the reasons for checking armature and fields.
2. Explain the steps in checking armature and fields.
3. Demonstrate the proper procedure in checking armature and fields.
4. Have student to list the steps in testing armature and fields.
5. Assign the student task of checking armature and fields.
6. Discuss the starter, its function and purpose.
7. Identify all the parts of a starter.

CRITERION REFERENCED MEASURE:

Practical Application:
Given a starter, mechanics tool set, armature tester, continuity tester, voltmeter, ammeter, and tachometer, check the armature and fields.

Method of Evaluating Practical Application:
Using the checklist for PO #65. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 65 EVALUATION

PERFORMANCE TEST FOR CHECKING ARMATURE AND FIELDS

Student's Name **Date**

DIRECTIONS TO STUDENT: Check the armature and fields on the starter. All steps on the checklist must be completed.

DIRECTION TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Completed ground test.		
2. Completed short test.		
3. Completed balance test.		
4. Tested field.		

APPROVED Yes ___ No ___

Student's Name **Date**

DUTY: MAINTAINING AND SERVICING THE STARTING CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 66

TASK: Check ignition switch.

STANDARD OF PERFORMANCE OF TASK:
In the laboratory area, check an ignition switch on the designated tractor. The continuity tester readings should agree with those of the instructor.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK: Given a set of screwdrivers, pliers, ignition wrenches, and a continuity tester or ohmmeter, check an ignition switch on the designated tractor.

ENABLING OBJECTIVE(S):

1. Know safety precautions.
2. Ability to read.
3. Use of hand tools.

RESOURCES:

1. Manufacturer's service manual.
2. **Fundamentals of Service - Electrical Systems**, pp. 5-9 through 5-10, 7-15.

TEACHING ACTIVITIES:

1. Discuss the reason for checking the ignition switch.
2. Explain the steps in checking the ignition switch.
3. Demonstrate the proper procedure in checking the ignition switch.
4. Review the steps in checking the ignition switch.
5. Have student to check the ignition switch.

CRITERION REFERENCED MEASURE:

Practical Application:
Given a set of screwdrivers, pliers, ignition wrenches, and continuity tester or ohmmeter, check the ignition switch on a designated tractor.

Method of Evaluating Practical Application:
The continuity tester readings should be 100% accurate when compared to the readings obtained by the instructor.

PERFORMANCE OBJECTIVE V-TECS 66

PERFORMANCE GUIDE:

1. Disconnect all wires from switch (noting their position so they can be reconnected).
2. Attach continuity tester across "Battery" and "Ignition" terminals of the ignition switch.
3. Turn switch to "Start" and check for contact. Shake switch to check for shorts.
4. Attach continuity tester across "Battery" and "Start" terminals of the switch.
5. Turn switch to "Start" and check for contact.
6. Remove continuity tester and reconnect wires to switch or replace ignition switch if faulty.

DUTY: MAINTAINING AND SERVICING THE STARTING CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 67

TASK: Check safety switches.

STANDARD OF PERFORMANCE OF TASK:
In the laboratory area, check the safety switch on the designated tractor. The reading on the continuity tester or ohmmeter should agree with the instructor's reading.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK;
Given a set of screw drivers, pliers, ignition wrenches and a continuity tester ohmmeter, check the safety switch on the designated tractor.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Use of hand tools.

RESOURCES:

1. Manufacturer's Service Manual.
2. **Fundamentals of Service - Electrical Systems,** pp. 7-15 through 7-17.

TEACHING ACTIVITIES:

1. Discuss the reason for checking safety switches.
2. Explain the steps in checking safety switches.
3. Demonstrate the proper procedure in checking safety switches.
4. Have student to list the steps in checking safety switches.
5. Have student to check safety switches.
6. Discuss and list the functions of safety switches.

CRITERION REFERENCED MEASURE:

Practical Application:
Given a set of screwdrivers, pliers, ignition wrenches, and a continuity-tester, ohmmeter, check the safety switch on a designated tractor.

Method of Evaluating Practical Application:
The continuity tester readings should be 100% accurate when compared to the readings obtained by the instructor.

PERFORMANCE OBJECTIVE V-TECS 67

PERFORMANCE GUIDE:

1. Disconnect wires from safety switch.
2. Attach continuity tester across switch terminals.
3. Activate switch and check for contact. If there is continuity, the safety switch is shorted.
4. Remove continuity tester and reconnect wires to safety switch.
5. Replace safety switch if faulty.

DUTY: MAINTAINING AND SERVICING THE STARTING CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 68

TASK: Check solenoid.

STANDARD OF PERFORMANCE OF TASK:
In the laboratory area, check the solenoid on the designated tractor. The voltmeter reading should agree with the instructor's reading.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK: Given a set of ignition wrenches, an open-end wrench set, a D.C. voltmeter or a multi-meter, check a solenoid on the designated tractor.

ENABLING OBJECTIVE(S):
1. Ability to read.
2. Use of hand tools.

RESOURCES:
1. Manufacturer's service manual.
2. **Fundamentals of Service Electrical Systems**, pp. 7-14.

TEACHING ACTIVITIES:
1. Explain the importance and function of the solenoid.
2. Discuss the steps in checking the solenoid.
3. Demonstrate the proper procedure in checking the solenoid.
4. Have student identify the steps in checking the solenoid.
5. Have student to check solenoid.

CRITERION REFERENCED MEASURE:

Practical Application:
Given a set of ignition wrenches, an open-end wrench set, a D.C. voltmeter or a multi-meter, check a solenoid on a designated tractor.

Method of Evaluating Practical Application:
The student's voltmeter reading should be 100% accurate when compared to the reading obtained by the instructor.

PERFORMANCE OBJECTIVE V-TECS 68

PERFORMANCE GUIDE:

1. Disconnect solenoid to starter cable connection from the solenoid.
2. Connect voltmeter from starter terminal of the solenoid to ground.
3. Activate starter switch and observe reading on voltmeter for battery voltage.
4. Remove voltmeter and reconnect starter cable.

DUTY: MAINTAINING AND SERVICING THE STARTING CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 69

TASK: Replace bearing and bushings.

STANDARD OF PERFORMANCE OF TASK:
In the shop area, replace the bearings and bushings on the designated starter. The bushings will be installed without damage to other parts and the starter will function properly. All steps on an instructor's checklist will be completed.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK: Given an open-end and a box-end wrench set, screwdrivers, bushing puller and driver set, an adjustable reamer, and specified bearing lubricant, replace the bearings and bushings on the designated starter.

ENABLING OBJECTIVE(S):

1. Know safety precautions.
2. Use of hand tools.

RESOURCES:

1. **Tractor Maintenance: Principles and Procedures**, pp. 10-1 through 10-6.
2. **Fundamentals of Service Electrical Systems**, pp. 1-17 through 1-19.

TEACHING ACTIVITIES:

1. Emphasize the importance of replacing bearings and bushings.
2. List the steps in replacing bearings and bushings.
3. Demonstrate the proper procedure in replacing bearings and bushings.
4. Review the steps in replacing bearings and bushings.
5. Have student to perform the task of replacing bearings and bushings.

CRITERION REFERENCED MEASURE:

Practical Application:
Given the necessary tools and equipment, replace the bearings and bushings on a designated starter.

Method of Evaluating Practical Application:
Using the checklist for PO #69. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 69 EVALUATION

PERFORMANCE TEST FOR REPLACING BEARINGS AND BUSHINGS

Student's Name **Date**

DIRECTIONS TO STUDENT: Replace the bearings and bushings on the starter. Installed bearings and bushings will be installed without damage to other parts, starter will function properly and all steps on the checklist will be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Removed starter.	______	______
2. Dismantled starter.	______	______
3. Installed new bushings.	______	______
4. Assembled starter.	______	______
5. Bench tested starter.	______	______
6. Installed and tested the starter on the tractor.	______	______

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING THE STARTING CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 70

TASK: Replace ring gear.

STANDARD OF PERFORMANCE OF TASK:
In the shop area, replace a ring gear on the flywheel of the designated tractor. The ring gear will be installed without damage to any parts (except the old ring gear) and the starter will function properly.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK: Given ring gear, complete tool set, and oven or torch to heat ring gear, replace the ring gear on the flywheel of the designated tractor.

ENABLING OBJECTIVE(S):

1. Know safety precautions.
2. Use of hand tools.

RESOURCES:

1. Manufacturer's service manual.
2. **Fundamentals of Service Engines**, pp. 2-61 through 2-62.

TEACHING ACTIVITIES:

1. Discuss the function of the ring gear.
2. Explain the reasons for replacing ring gear.
3. Discuss the steps in replacing a ring gear.
4. Demonstrate the proper procedure in replacing ring gear.
5. Have the student identify the steps in replacing ring gear.
6. Have student to replace ring gear.

CRITERION REFERENCED MEASURE:

Practical Application:
The necessary tools and equipment, replace the ring gear on the flywheel of a designated tractor.

Method of Evaluating Practical Application:
The student will replace a ring gear on the flywheel of a designated tractor. The ring gear will be installed without damage to any other part (except the old ring gear) and the starter will function properly.

PERFORMANCE OBJECTIVE V-TECS 70

PERFORMANCE GUIDE:

1. Remove flywheel. (This generally requires the removal of the clutch from the flywheel).
2. Remove old ring gear with hammer and chisel or torch, being careful not to damage the flywheel.
3. Heat new ring gear in the oven until it expands enough to slip easily on the flywheel.
4. Install ring gear on flywheel with rounded end of gear teeth toward the starter.
5. Reinstall flywheel.

DUTY: MAINTAINING AND SERVICING THE STARTING CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 71

TASK: Replace starter brushes.

STANDARD OF PERFORMANCE OF TASK:
Replace the starter brushes on the designated starter. There will be no damage to any parts, all parts will be torqued to specifications, and the starter will operate when current is supplied.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Using the designated engine, a mechanic's tool set, an inch/pound torque wrench and new starter brushes, replace the starter brushes.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Use of hand tools.

RESOURCES:

1. **Tractor Maintenance: Principles and Procedures,** pp. 102-107.
2. **Fundamentals of Service - Electrical Systems,** pp. 5-1 through 5-34.

TEACHING ACTIVITIES:

1. Have students read **FOS - Electrical Systems** pp. 5-1 through 5-34 and discuss.
2. Discuss the reasons for replacing starter brushes.
3. List the steps in replacing starter brushes.
4. Demonstrate the procedure followed in replacing starter brushes.
5. Have student list steps in replacing starter brushes.

CRITERION REFERENCED MEASURE:

Practical Application:
Given the necessary tools and equipment, replace the starter drive on a designated tractor.

Method of Evaluating Practical Application:
There will be no damage to any parts, all parts will be torqued to specifications, and the starter will operate when current is applied.

PERFORMANCE OBJECTIVE V-TECS 71

PERFORMANCE GUIDE

1. Take all brushes out of their retainers and hang them outside of starter frame.
2. Put starter drive yoke return spring into recess of drive end housing and install housing to starter frame.
3. Install brush end plate with end plate boss aligned with starter frame slot and install the through bolts. Tighten to 55-75 inch/pounds torque. (Make sure that stop ring retainer is correctly seated in the drive end housing).
4. With a hook, pull back on the brush springs and insert the brushes into their holders.
5. Cover the brush openings with water-proof tape. Install the drive yoke cover and gasket. Install the brush cover bank and tighten the retaining screw.
6. Lubricate the drive end of the armature and install drive end housing seal using a socket or other suitable tool.
7. Connect starter to battery, being careful not to over tighten cable, and check operation.

DUTY: MAINTAINING AND SERVICING THE STARTING CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 72

TASK: Replace starter drive.

STANDARD OF PERFORMANCE OF TASK:
Replace the starter drive on the designated tractor. All steps on an instructor's checklist must be completed acceptably.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a new starter drive and a tool set, replace the starter drive on the designated tractor.

ENABLING OBJECTIVE:

1. Use of hand tools.

RESOURCES:

1. Manufacturer's service manual.

TEACHING ACTIVITIES:

1. Discuss the reasons for replacing starter drive.
2. Explain the steps in replacing starter drive.
3. Demonstrate the proper procedure in replacing starter drive.
4. Have student list the steps for replacing starter drive.
5. Have student to replace starter drive.

CRITERION REFERENCED MEASURE:

Practical Application:
Given the necessary tools and equipment, replace the starter drive on a designated tractor.

Method of Evaluating Practical Application:
Using the checklist for PO #72. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 72 EVALUATION

PERFORMANCE TEST FOR REPLACING STARTER DRIVE

Student's Name **Date**

DIRECTIONS TO STUDENT: Replace the starter drive. All steps on the checklist will be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1. Removed starter.	______	______
2. Removed starter drive.	______	______
3. Installed new drive.	______	______
4. Installed starter.	______	______
5. Checked operation of starter.	______	______

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING THE STARTING CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 73

TASK: Replace starter motor solenoid.

STANDARD OF PERFORMANCE OF TASK:
Replace the starter motor solenoid on a designated starter motor. The disassembly and reassembly order will follow the steps outlined in the service manual. There will be no damage to any parts and the solenoid will operate according to manufacturer's specifications.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given the necessary replacement parts, a manufacturer's service manual, and mechanic tool set, replace a starter motor solenoid.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Use of hand tools.

RESOURCES:

1. Manufacturer's service manual.

TEACHING ACTIVITIES:

1. Explain the function of the starter solenoid.
2. Discuss the steps in replacing starter motor solenoid.
3. Demonstrate the proper procedure in replacing starter motor solenoid.
4. Have the student identify the steps in replacing starter motor solenoid.
5. Have the student perform the task of replacing starter motor solenoid.

CRITERION REFERENCED MEASURE:

Practical Application:
Given the necessary tools and equipment, replace a starter motor solenoid.

Method of Evaluating Practical Application:
Replace the starter motor solenoid on a designated starter motor. The disassembly and reassembly order will follow the steps outlined in the service manual. There will be no damage to any parts and the solenoid will operate according to manufacturer's specifications.

PERFORMANCE OBJECTIVE V-TECS 73

PERFORMANCE GUIDE:

Note: The starter motor solenoid is usually a "built-in" component. Check the service manual for specific instructions.

Solenoid contact assembly replacement:

1. Remove the starter components as outlined in the service manual, identifying parts during disassembly to facilitate reassembly.
2. Unsolder the contact post from the field coil connecting strap, using a heavy duty soldering iron or a small flame propane torch.
3. Cut off the head of the contact spring retaining rivet with a sharp chisel and throw away the contact spring. (Use an 8/32" N.C. tap to cut threads in the rivet hole).
4. Remove the contact post retaining screw and insulating washer; discard both.
5. Put the new contact spring and ground brush assembly, paper insulator, and contact post in position on the starter frame.
6. Install the insulating washer and retaining screw. Center the contact points and tighten the retaining screw securely. Stake the threaded end of the screw from inside the starter frame to manufacturer's specifications.
7. Clean the end of the field connecting strap and the slotted area of the contact post with fine sandpaper.
8. Insert the end of the field connector strap through the slot of the contact post and bend the end of the connector strap against the clean surface of the contact post.
9. Solder the connection with rosin core solder.
10. Remove the upper ground brush retaining screw and discard the brush.
11. Place the field ground lead terminal and new ground brush terminal block together and install the original retaining screw.
12. Install the armature and drive assembly, drive yoke, and drive yoke pivot pin. Add a few drops of oil to both ends of the armature shaft.
13. Slide the stop ring retainer into place on the armature shaft and position the drive yoke return spring in the drive end housing; then install the housing to the starter frame.
14. Install the end plate and the through bolts, and tighten securely. Insert the brushes in their holders.
15. Press on the starter drive yoke until the movable pole shoe is bottomed. Check the clearance between the new contact points and adjust to a .020 - .100 clearance.
16. Install protective tape over the brush openings of the starter frame, then install the drive yoke cover and gasket, and the brush cover band.
17. Install and tighten the brush cover band retaining screw.

DUTY: MAINTAINING AND SERVICING THE STARTING CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 74

TASK: Replace starter motors.

STANDARD OF PERFORMANCE OF TASK:
Replace the starter motor on the designated tractor. The starter will fit correctly, be fastened securely, and all connections will fit tightly. The replacement process will include the completion of all the steps on an instructor's checklist.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given an open-end and box- end wrench set, a socket set, and a new starter, replace the starter motor on the designated tractor.

ENABLING OBJECTIVE:

1. Use of hand tools.

RESOURCES:

1. Manufacturer's service manuals.

TEACHING ACTIVITIES:

1. Discuss the function of the starter motor.
2. Explain the steps in replacing starter motor.
3. Demonstrate the proper steps in replacing starter motors.
4. Review the proper procedure in replacing starter motors.
5. Have student to replace starter motor.

CRITERION REFERENCED MEASURE:

Practical Application:
Given the necessary tools and equipment, replace the starter motor on the designated tractor.

Method of Evaluating Practical Application
Use the checklist for PO #74. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 74 EVALUATION

PERFORMANCE TEST FOR REPLACING STARTER MOTORS

Student's Name **Date**

DIRECTIONS TO STUDENT: Replace the starter motor. The replaced starter will fit correctly, be fastened securely and all connections will fit tightly. All steps on the check list will be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1.	Disconnected starter.	______	______
2.	Removed starter from engine.	______	______
3.	Installed new starter.	______	______
4.	Replaced cable and ground.	______	______
5.	Checked correct operation.	______	______

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING THE STARTING CIRCUIT

PERFORMANCE OBJECTIVE V-TECS 75

TASK: Turn Armature.

STANDARD OF PERFORMANCE OF TASK:
In the laboratory area, turn the armature on a starter. The turning process should include the completion of all steps on the instructor's checklist.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a mechanic's tool set, an armature tester (growler), a continuity tester, and a metal lathe with mica undercutting attachment, turn an armature.

ENABLING OBJECTIVE(S):

1. Know safety procedure in using growler and continuity tester.
2. Ability to read.
3. Use of hand tools.

RESOURCES:

1. **Tractor Maintenance: Principles and Procedures,** pp. 102-108.
2. Manufacturer's service manual.

TEACHING ACTIVITIES:

1. Discuss reasons for turning armature.
2. Explain the steps in turning armature.
3. Demonstrate the proper steps in turning the armature on the metal lathe.
4. Have student list the steps in turning the armature.
5. Have student perform the task of turning a armature.

CRITERION REFERENCED MEASURE:

Practical Application:
Given the necessary tools and equipment, turn an armature.

Method of Evaluating Practical Application:
Use the checklist for PO #75. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 75 EVALUATION

PERFORMANCE TEST FOR TURNING ARMATURE

Student's Name **Date**

DIRECTIONS TO STUDENT: Turn the armature on a starter. All steps on the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Turned and cleaned commutator.	______	______
2.	Undercut mica between commutator bars.	______	______
3.	Removed burrs.	______	______
4.	Eliminated shorts, grounds, and open wiring.	______	______
5.	Correctly reassembled starter.	______	______

APPROVED Yes ___ No ___

Evaluator's Signature Date

MAINTAINING AND SERVICING
GASOLINE FUEL SYSTEM

DUTY: MAINTAINING AND SERVICING GASOLINE FUEL SYSTEM

PERFORMANCE OBJECTIVE V TECS 76

TASK: Adjust carburetor float.

STANDARD OF PERFORMANCE OF TASK:
Adjust the carburetor float on the designated tractor. The float will be adjusted to the right height as checked with a ruler, and engine will run smoothly after carburetor has been reassembled and installed. After engine has run and been turned off, the gasoline will not overflow in the carburetor bowl.

SOURCE OF STANDARD:
Kentucky Writing Team -- Supervisor.

CONDITIONS FOR PERFORMANCE OF TASK:
Given the manufacturer's service manual, end wrenches, screwdriver, pliers and a ruler, adjust a carburetor float.

ENABLING OBJECTIVE(S):

1. The student will be able to read a service manual.
2. The student will follow safety rules concerning hand tools and fuel systems.
3. The student must be able to read a ruler.

RESOURCES:

1. **Fundamentals of Service -- Engines,** pp. 3-16 to 3-19.
2. I and T Service Manual for specific tractor

TEACHING ACTIVITIES:

1. Explain to the students the importance of having the float set properly in a carburetor as related to engine performance and fuel economy.
2. Have students read FOS-Engines, Chapter 3, pp. 3-16 to 3-19.
3. Show them how to adjust a carburetor float.
4. Have them find the float setting for a specific carburetor in the service manual.
5. Give the student a carburetor and have them set the float level.

CRITERION REFERENCED MEASURE:

Practical Application:
Have students adjust carburetor float using the steps in the checklist.

Method of Evaluating Practical Application:
Use Instructor Checklist for Performance Objective 76. All steps must be rated satisfactorily.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 76 EVALUATION

PERFORMANCE TEST FOR ADJUSTING CARBURETOR FLOAT

Student's Name **Date**

DIRECTIONS TO STUDENT: Adjust carburetor float on assigned tractor. All steps in the performance guide must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1.	Shut off fuel valve and remove carburetor.	______	______
2.	Removed top half of carburetor.	______	______
3.	Removed float and inspected for leaks.	______	______
4.	Replaced float and set correct level (with ruler).	______	______
5.	Reassembled carburetor and installed on tractor.	______	______
6.	Turned on fuel and checked for leaks.	______	______

APPROVED Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING GASOLINE FUEL SYSTEM

PERFORMANCE OBJECTIVE V-TECS 77

TASK: Adjust carburetor idle air/fuel mixture.

STANDARD OF PERFORMANCE OF TASK:
Adjust the carburetor idle air/fuel mixture. When adjusted, the engine will run smoothly and no black smoke will come from the exhaust.

SOURCE OF STANDARD:
Kentucky Writing Team -- Incumbent Worker.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a screwdriver, adjust the carburetor idle air/fuel mixture.

ENABLING OBJECTIVE(S):

1. The student will be able to read a service manual.
2. The student will understand safety rules concerning hand tools and fuel system.

RESOURCES:

1. **Fundamentals of Service — Engines,** pp. 3-16 to 3-19.
2. I and T Service Manual for specific tractor.

TEACHING ACTIVITIES:

1. Discuss with students the importance of proper carburetor adjustment.
2. Have students read FOS-Engines, Chapter 3, pp. 3-16 to 3-19.
3. Pass around carburetor and locate adjusting screws for the students.
4. Have students find the proper carburetor adjustments for a specific tractor.
5. Assign student a engine and have them adjust the carburetor.

CRITERION REFERENCED MEASURE:

Practical Application:
Have student idle/air fuel mixture using the steps in the performance guide.

Method of Evaluating Practical Application:
Use Instructors Checklist for Performance Objective 77. All steps must be rated satisfactorily.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 77 EVALUATION

PERFORMANCE TEST FOR ADJUSTING CARBURETOR IDLE AIR/FUEL MIXTURE

Student's Name **Date**

DIRECTIONS TO STUDENT: Adjust idle/air fuel mixture on assigned tractor. All steps in the performance guide must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Checked air cleaner.	______	______
2. Started engine and let it warm up to operating temperature.	______	______
3. Adjusted idle air/fuel mixture.	______	______
4. Revved up engine a few times and let idle.	______	______
5. Check idle rpms with tachometer.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING GASOLINE FUEL SYSTEM

PERFORMANCE OBJECTIVE V-TECS 78

TASK: Adjust engine idle speed.

STANDARD OF PERFORMANCE OF TASK:
Adjust the engine idle speed on the designated tractor. Check hour meter and compare with recommended RPM's in operator's manual. If there is no hour meter, the tractor should move at idle speed when in first and second gear.

SOURCE OF STANDARD:
Kentucky Writing Team -- Supervisor.

CONDITIONS FOR PERFORMANCE OF TASK:
Given the manufacturer's operator's manual and a screwdriver, adjust the engine idle speed.

ENABLING OBJECTIVE(S):

1. The student will be able to read a service manual.
2. The student will follow safety rules concerning hand tools and fuel systems.
3. The student must be able to attach a tachometer to engine to test rpms.

RESOURCES:

1. **Fundamentals of Service — Engines,** pp. 3-12 to 3-18.
2. I and T Service Manual for specific tractor.

TEACHING ACTIVITIES:

1. Explain to the students the importance of keeping idle speed set for proper lubrication.
2. Have students read FOS Engines, Chapter 3, pp. 3-12 to 3-18.
3. Have student find idle speed specifications in service manual.
4. Show students how to set idle speed on a tractor.
5. Assign students a tractor and have them set the idle speed.

CRITERION REFERENCED MEASURE:

Practical Application:
Have student adjust engine idle speed using the steps in the performance guide.

Method of Evaluating Practical Application:
Use instructor checklist for Performance Objective 78. All steps must be rated satisfactorily.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 78 EVALUATION

PERFORMANCE TEST FOR ADJUSTING ENGINE IDLE SPEED

Student's Name **Date**

DIRECTIONS TO STUDENT: Adjust engine idle speed on assigned tractor. All the steps in the performance guide must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Made sure air cleaner is clean.	______	______
2. Started engine and let it warm up to operating temperature.	______	______
3. Adjusted idle speed screw until engine is at correct rpm.	______	______
4. Rev up engine a few times and let idle.	______	______
5. Checked idle speed with tachometer.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING GASOLINE FUEL SYSTEM

PERFORMANCE OBJECTIVE V-TECS 79

TASK: Clean carburetor.

STANDARD OF PERFORMANCE OF TASK:
Clean the carburetor on the designated tractor. Upon inspection the inside of the carburetor will be clean. No jets or holes will be plugged and the engine will operate properly.

SOURCE OF STANDARD:
Kentucky Writing Team -- Supervisor.

CONDITIONS FOR PERFORMANCE OF TASK:
Given end wrenches, screwdrivers, clean rags, solvent, safety glasses or face shield, and an air hose, clean the carburetor on a gasoline powered tractor.

ENABLING OBJECTIVE(S):

1. The student will be able to read a service manual.
2. The student will follow safety rules concerning hand tools and fuel systems.

RESOURCES:

1. **Fundamentals of Service — Engines,** pp. 3-12 to 3-18.
2. I and T Service Manual for specific tractor.

TEACHING ACTIVITIES:

1. Explain the importance of cleaning a carburetor.
2. Have students read FOS Engines, Chapter 3, pp. 3-12 to 3-18.
3. Disassemble a carburetor in class and show students how to rebuild it.
4. Have students list the carburetor overhaul procedure from you in class demonstration.
5. Assign students a carburetor and have them disassemble, clean, and rebuild it.

CRITERION REFERENCED MEASURE:

Practical Application:
Have students clean carburetor using the steps in the performance guide.

Method of Evaluating Practical Application:
Use instructor checklist for Performance Objective 79. All steps must be rated satisfactorily.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 79 EVALUATION

PERFORMANCE TEST FOR CLEANING CARBURETOR

Student's Name **Date**

DIRECTIONS TO STUDENT: Clean carburetor on assigned tractor. All steps in the performance guide must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1. Shut off fuel valve and remove carburetor.		
2. Disassembled carburetor.		
3. Put disassembled carburetor in carburetor cleaner.		
4. Removed from carburetor cleaner.		
5. Washed all the parts with water to remove carburetor cleaner.		
6. Blew dry with compressed air.		
7. Reassembled carburetor with new gaskets.		
8. Installed, cranked engine, and adjusted carburetor.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING GASOLINE FUEL SYSTEM

PERFORMANCE OBJECTIVE V-TECS 80

TASK: Clean settling bulb (sediment bowl).

STANDARD OF PERFORMANCE OF TASK:
Clean the settling bulb on the designated tractor. Upon visual inspection, the bulb will be clean of dirt and foreign matter and there will be no leak around the gasket.

SOURCE OF STANDARD:
Kentucky Writing Team -- Supervisor.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a clean rag and a tractor with a settling bulb, clean the settling bulb.

ENABLING OBJECTIVE(S):

1. The student will be able to read a service manual.
2. The student will follow safety rules concerning hand tools and fuel systems.

RESOURCES:

1. **Fundamentals of Service — Engines,** pp. 3-1 to 3-19.
2. I and T Service Manual for specific tractor.

TEACHING ACTIVITIES:

1. Explain to the students the importance of clean fuel going into the carburetor.
2. Have students read FOS Engines, Chapter 3, pp. 3-1 to 3-19.
3. Review with class different examples of sediment bowls.
4. Demonstrate the cleaning of sediment bowls.
5. Assign student to a tractor and have them clean sediment bowl.

CRITERION REFERENCED MEASURE:

Practical Application:
Have students clean settling bulb (sediment bowl) using the steps in the performance guide.

Method of Evaluating Practical Application:
Use Instructor Checklist for Performance Objective 80. All steps must be rated satisfactorily.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 80 EVALUATION

PERFORMANCE TEST FOR CLEANING SETTLING BULB (SEDIMENT BOWL)

Student's Name **Date**

DIRECTIONS TO STUDENT: Clean settling bulb on assigned tractor. All steps in the performance guide must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Turned off fuel at shut off valve.	________	________
2.	Removed glass bowl, screen, and gasket.	________	________
3.	Cleaned glass bowl and screen.	________	________
4.	Checked for damaged bowl and gasket.	________	________
5.	Opened shut off valve and let a little gas flow out.	________	________
6.	Replaced screen, gasket, and glass bowl.	________	________
7.	Turned on fuel and checked for leaks.	________	________

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING GASOLINE FUEL SYSTEM

PERFORMANCE OBJECTIVE V-TECS 81

TASK: Install carburetor repair kit.

STANDARD OF PERFORMANCE OF TASK:
Install a carburetor repair kit on the designated tractor. There should be no fuel leaks in the carburetor, idling, or under load. The engine should run at service manual specifications. The actual work time should not exceed 1 1/2 hours, excluding time parts are in cleaning solution.

SOURCE OF STANDARD:
Kentucky Writing Team -- Supervisor.

CONDITIONS FOR PERFORMANCE OF TASK:
Given an assorted set of end wrenches, a service manual, screwdrivers, needle nose pliers, carburetor cleaner, and a dynamometer, install a carburetor repair kit on the designated tractor.

ENABLING OBJECTIVE(S):

1. The student will be able to read a service manual.
2. The student will follow safety rules concerning hand tools and fuel system safety.
3. Knowledge of dynamometer operation.

RESOURCES:

1. **Fundamentals of Service — Engines,** pp. 3-8 to 3-19.
2. I and T Service Manual for specific tractor.

TEACHING ACTIVITIES:

1. Discuss with the students the importance of a good working carburetor.
2. Read FOS Engines, Chapter 3, pp. 3-8 to 3-19.
3. Demonstrate the rebuilding of a carburetor in class.
4. Have students find rebuild specifications in repair manual.
5. Assign students a carburetor and have them rebuild it.

CRITERION REFERENCED MEASURE:

Practical Application:
Have students install carburetor repair kit using the steps in the performance guide.

Method of Evaluating Practical Application:
Use instruction checklist for Performance Objective 81. All steps must be rated satisfactorily.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 81 EVALUATION

PERFORMANCE TEST FOR INSTALLING CARBURETOR REPAIR KIT

Student's Name **Date**

DIRECTIONS TO STUDENT: Install carburetor repair kit on assigned tractor. All steps in the performance guide must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Shut off fuel and removed carburetor.		
2. Disassembled carburetor.		
3. Placed in carburetor cleaner.		
4. Removed from carburetor cleaner.		
5. Washed carburetor parts with water.		
6. Blew dry with compressed air.		
7. Replaced all jets with new ones from kit.		
8. Replaced all new parts from carburetor kit.		
9. Set float level.		
10. Installed carburetor and adjusted.		
11. Cranked engine and readjusted carburetor.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING GASOLINE FUEL SYSTEM

PERFORMANCE OBJECTIVE V-TECS 82

TASK: Replace fuel pump.

STANDARD OF PERFORMANCE OF TASK:
In the laboratory area, replace the fuel pump on the designated tractor. When completed, the pump will show no visible signs of leaks. During the replacement process all steps on the instructor checklist will be completed.

SOURCE OF STANDARD:
Kentucky Writing Team -- Supervisor.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a new fuel pump, a set of flare nut wrenches, a small socket set, an open-end wrench set, sealing compound and a putty knife or scraper, replace the fuel pump on the designated tractor.

ENABLING OBJECTIVE(S):

1. The student will be able to read a service manual.
2. The student will follow safety rules concerning hand tools and fuel system safety.

RESOURCES:

1. **Fundamentals of Service -- Engines,** pp. 3-1 to 3-8.
2. I and T Service Manual for specific tractor.

TEACHING ACTIVITIES:

1. Explain to the students the importance of proper fuel pump operation.
2. Have students read **FOS - Engines,** Chapter 3, pp. 3-1 to 3-8.
3. Pass around and discuss examples of fuel pumps.
4. Demonstrate to students correct fuel pump replacement.
5. Assign students an engine and have them replace the fuel pump.

CRITERION REFERENCED MEASURE:

Practical Application:
Have students replace fuel pump using the steps in the performance guide.

Method of Evaluating Practical Application:
Use instructor checklist for Performance Objective 82. All steps must be rated satisfactorily.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 82 EVALUATION

PERFORMANCE TEST FOR REPLACING FUEL PUMP

Student's Name **Date**

DIRECTIONS TO STUDENT: Replace fuel pump on assigned tractor. All steps in the performance guide must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Turned off fuel.		
2. Removed fuel lines from fuel pump.		
3. Removed fuel pump.		
4. Cleaned off old gasket.		
5. Applied new gasket and sealer.		
6. Installed new fuel pump.		
7. Installed lines.		
8. Turned on fuel and checked for leaks.		
9. Cranked engine and checked for leaks.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING GASOLINE FUEL SYSTEM

PERFORMANCE OBJECTIVE V-TECS 83

TASK: Service a fuel pump (diaphragm type).

STANDARD OF PERFORMANCE OF TASK:
Service the fuel pump on the designated tractor. Upon inspection there will be no leaks nor fuel dilution, and the task will be performed within five minutes of the time stated by the instructor.

SOURCE OF STANDARD:
Kentucky Writing Team -- Supervisor.

CONDITIONS FOR PERFORMANCE OF TASK:
Given assorted wrenches and screwdrivers, needle nose pliers, and replacement parts if needed, service a fuel pump.

ENABLING OBJECTIVE(S):

1. The student will be able to read a service manual.
2. The student will follow safety rules concerning hand tools and fuel system safety.

RESOURCES:

1. **Fundamentals of Service — Engines,** pp. 3-1 to 3-8.
2. I and T Service Manual for specific tractor.

TEACHING ACTIVITIES:

1. Explain to the students the importance of proper fuel pump operation.
2. Have students read FOS Engines, Chapter 3, pp. 3-1 to 3-8.
3. Pass around and discuss examples of fuel pumps.
4. Demonstrate to student how to rebuild a diaphragm fuel pump.
5. Assign a fuel pump to the students and have students rebuild it.

CRITERION REFERENCED MEASURE:

Practical Application:
Have students service a fuel pump using the steps in the performance guide.

Method of Evaluating Practical Application:
Use instructor checklist for Performance Objective 83. All steps must be rated satisfactorily.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 83 EVALUATION

PERFORMANCE TEST FOR SERVICING A FUEL PUMP

Student's Name **Date**

DIRECTIONS TO STUDENT: Service a fuel pump on assigned tractor. All steps in the performance guide must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1. Turned off fuel and removed fuel pump.		
2. Disassembled fuel pump and cleaned it.		
3. Replaced diaphragm.		
4. Reassembled fuel pump.		
5. Installed fuel pump.		
6. Turned on fuel.		
7. Cranked engine and checked for leak.		

APPROVED: Yes _____ No _____

Evaluator's Signature Date

DUTY: MAINTAINING AND SERVICING GASOLINE FUEL SYSTEM

PERFORMANCE OBJECTIVE V-TECS 84

TASK: Service fuel tanks and fuel lines.

STANDARD OF PERFORMANCE OF TASK:
Service the fuel tank and fuel lines on the designated tractor. There will be no dirt in the settling bulb (sediment bowl) and no leaks in the fuel valve, settling bulb, or fuel line connections.

SOURCE OF STANDARD:
Kentucky Writing Team -- Supervisor.

CONDITIONS FOR PERFORMANCE OF TASK:
Given assorted wrenches and clean rags, service a fuel tank and fuel lines.

ENABLING OBJECTIVE(S):

1. The student will be able to read a service manual.
2. The student will follow safety rules concerning hand tools and fuel system safety.

RESOURCES:

1. **Fundamentals of Service -- Engines,** pp. 3-1 to 3-8.
2. I and T Service Manual for specific tractor.

TEACHING ACTIVITIES:

1. Discuss with students the importance of having a clean fuel tank and lines.
2. Read **FOS - Engines,** Chapter 3, pp. 3-1 to 3-8.
3. Explain to student the importance of safety when cleaning and servicing fuel tanks and lines.
4. Show students how to service fuel tanks and lines.
5. Assign students a tractor and have them service the full tank and lines.

CRITERION REFERENCED MEASURE:

Practical Application:
Have students service fuel tanks and full lines using the steps in the performance guide.

Method of Evaluating Practical Application:
Use instructor checklist for Performance Objective 84. All steps must be rated satisfactorily.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 84 EVALUATION

PERFORMANCE TEST FOR SERVICING FUEL TANKS AND FUEL LINES

Student's Name **Date**

DIRECTIONS TO STUDENT: Service fuel tanks and fuel lines on assigned tractor. All items in the performance guide must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Drained all the fuel.	______	______
2. Removed fuel shut off valve.	______	______
3. Cleaned tank with clean fuel.	______	______
4. Cleaned lines.	______	______
5. Cleaned settling bowl.	______	______
6. Reconnected all lines and refilled tank.	______	______
7. Checked for leaks.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

MAINTAINING AND SERVICING DIESEL FUEL SYSTEM

DUTY: MAINTAINING AND SERVICING DIESEL FUEL SYSTEM

PERFORMANCE OBJECTIVE V-TECS 85

TASK: Bleed a diesel fuel system.

STANDARD OF PERFORMANCE OF TASK:
Bleed the diesel fuel system on the designated tractor. The fuel system will be bled in such a way as to removal of all air from the lines. There will be no damage to any parts and the engine will start again.

SOURCE OF STANDARD:
Kentucky Writing Team - Supervisor.

CONDITIONS FOR PERFORMANCE OF TASK: Using the designated tractor, an operator's manual, suitable wrenches, and diesel fuel, bleed a diesel fuel system.

ENABLING OBJECTIVE(S):

1. Use of hand tools.
2. Ability to read manuals.

RESOURCES:

1. Tractor manufacturer's manual.

TEACHING ACTIVITIES:

1. Discuss diesel fuel.
2. Explain problems resulting from air in the fuel system.
3. Discuss the reasons why an engine will not crank with air in the system.
4. Demonstrate the removal of air from the fuel system.
5. Have student explain how the air is removed from the system.

CRITERION REFERENCED MEASURE:

Practical Application:
Student will bleed a diesel fuel system.

Method of Evaluating Practical Application:
Use checklist for PO #85. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 85 EVALUATION

PERFORMANCE TEST FOR BLEEDING A DIESEL FUEL SYSTEM

Student's Name **Date**

DIRECTIONS TO STUDENT: Bleed the diesel fuel system. All airmust be removed and no parts will be damaged. The engine must start and run. All items on checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1. Checked operator's manual for system's recommended bleeding order.	______	______
2. Checked to make sure there is clean fuel in fuel tank.	______	______
3. Turned on fuel cut-off at tank.	______	______
4. Loosened bleed plugs at primary fuel filter.	______	______
5. Activated manual fuel pump lever on priming pump until clean fuel flows from filter.	______	______
6. Closed primary bleed plug and opened secondary fuel filter bleed plug.	______	______
7. Activated fuel pump lever on priming pump until clean fuel came from secondary filter.	______	______
8. Closed bleed plug and continued to operate fuel pump for 10-12 strokes.	______	______
9. Used appropriate wrenches and loosened injector high pressure lines at nozzle.	______	______
10. Turned engine over until fuel with no air comes out at connection.	______	______
11. Tightened lines and repeated procedure until all nozzle lines are bled.	______	______
12. Turned engine over and started.	______	______
13. If engine fails to start, repeated procedure to remove air left from first bleeding.	______	______

APPROVED Yes ___ No ___

Evaluator's Signature Date

DUTY: MAINTAINING AND SERVICING DIESEL FUEL SYSTEM

PERFORMANCE OBJECTIVE V-TECS 86

TASK: Service diesel fuel filters.

STANDARD OF PERFORMANCE OF TASK:
Service the diesel fuel filters on the designated tractor. The fuel system should be clean with no leaks, bled properly, and the engine should start.

SOURCE OF STANDARD:
Kentucky Writing Team - Supervisor.

CONDITIONS FOR PERFORMANCE OF TASK: Using the designated tractor, an operator's manual, replacement filters and gasket, clean rags, and suitable wrenches, service the diesel fuel filters.

ENABLING OBJECTIVE(S):

1. Use of hand tools.
2. Ability to read.

RESOURCES:

1. Filter chart.
2. Tractor manufacturer's manual.

TEACHING ACTIVITIES:

1. Explain how filters work.
2. List the reasons for using filters.
3. Demonstrate how to bleed air from fuel system (PO #85).
4. Demonstrate the process for changing filters.
5. Have students list the steps in servicing fuel filters.

CRITERION REFERENCED MEASURE:

Practical Application:
The student will service the fuel filters.

Method of Evaluating Practical Application:
Use checklist for PO #86. All items must be completed.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 86 EVALUATION

PERFORMANCE TEST FOR SERVICING DIESEL FUEL FILTERS

Student's Name **Date**

DIRECTIONS TO STUDENT: Service the diesel fuel filters. The serviced system must be clean, have no leaks, be bled properly and the engine must start. All steps on the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Obtained correct filter elements.	________	________
2.	Shut off fuel.	________	________
3.	Removed primary filter, cleaned the container, and installed new filter.	________	________
4.	Removed old gasket and installed new gasket found in new element kit.	________	________
5.	Reinstalled filter element and container to engine.	________	________
6.	Tightened bolt to compress gasket.	________	________
7.	Repeated procedures 3-6 with secondary filter.	________	________
8.	Turned on fuel.	________	________
9.	Bled system and started engine.	________	________
10.	Checked filter for leaks and wiped off excess fuel to prevent dust accumulation.	________	________

APPROVED Yes ___ No ___

Evaluator's Signature Date

DUTY: MAINTAINING AND SERVICING DIESEL FUEL SYSTEM

PERFORMANCE OBJECTIVE V-TECS 87

TASK: Service a diesel fuel injector.

STANDARD OF PERFORMANCE OF TASK:
In the shop area, service a faulty nozzle and make it work correctly. All parts will fit correctly; there will be no leaks, and the nozzle will operate at pressure specified in service manual.

SOURCE OF STANDARD:
Kentucky Writing Team - Supervisor.

CONDITIONS FOR PERFORMANCE OF TASK: Given a Roosa-Master tool set for service of nozzles, an injector nozzle popper, appropriate fittings, and a service manual, service a diesel fuel injector.

ENABLING OBJECTIVE(S):

1. Use of hand tools.
2. Ability to read and interpret technical information.

RESOURCES:

1. Roosa-Master tool set manual.
1. Tractor Manufacturer's manual.

TEACHING ACTIVITIES:

1. Explain the function of fuel injectors.
2. Describe how fuel injectors are removed.
3. Demonstrate proper use of Roosa-Master tool set.
4. Demonstrate the correct servicing of a diesel fuel injector.
5. Have student list the steps to be followed in servicing a diesel fuel injector.

CRITERION REFERENCED MEASURE:

Practical Application:
Student will service a diesel fuel injector. The injector will function properly after servicing.

Method of Evaluating Practical Application:
Use checklist for PO #87. All steps must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 87 EVALUATION

PERFORMANCE TEST FOR SERVICING A DIESEL FUEL INJECTOR

Student's Name **Date**

DIRECTIONS TO STUDENT: Service a faulty diesel fuel injector. Serviced injector must work correctly. All parts will fit, there will be no leaks and the injector will operate at specified pressure. All steps in checklist will be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Removed faulty injector from engine.		
2.	Cleaned unit in clean diesel fuel.		
3.	Removed carbon dam seal and sealing washer.		
4.	Removed carbon from tip with brass wire brush.		
5.	Inserted nozzle in holding fixture and inserted in vise.		
6.	Loosened lock nut and removed pressure adjusting screw, washer, and spring.		
7.	Removed nozzle valve from body.		
8.	Cleaned slip opening with 0.008 cleaning needle in pin vise.		
9.	Cleaned seat valve tip scraper.		
10.	Used sac hole drill to remove carbon from sac hole.		
11.	Polished guide to body.		
12.	Cleaned lapping compound out completely and reassembled nozzle. Backed lift adjusting screw out several turns to prevent bottoming during reassembly.		
13.	Installed on a nozzle tester to set opening pressure, pattern, and leak off.		
14.	Checked manufacturer's specifications for correct opening pressure, leak off and other requirements.		
15.	Operated the tester to remove all air, and pumped the lever at about 60 strokes per minute.		
16.	Observed spray pattern and nozzle sound.		

PERFORMANCE OBJECTIVE V-TECS 87 CHECKLIST (Continued)

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
17. Pumped the lever until the nozzle just begins to open and note the pressure.	________	________
18. Turned in and out adjusting screw until correct opening pressure is obtained.	________	________
19. Turned valve lift adjusting screw until it just begins to bottom and then back out until the correct nozzle lift is obtained.	________	________
20. Locked nozzle nut down to correct torque.	________	________
21. Checked for seat leakage by bringing the nozzle up to approximately 1500 PSI and observing if fuel is leaking from tip of nozzle.	________	________
22. Raised pressure to 2400 PSI and observe seat.	________	________
23. Tilt the nozzle tip above horizontal and bring pressure up to 1500 PSI. Observe top end of nozzle and see if leakage is within specifications for the time.	________	________
24. Installed new carbon dam seals and top seals with appropriate tool.	________	________
25. Reinstalled nozzle into system if all checks are correct. Bleed systems and start engine.	________	________

APPROVED Yes ___ No ___

Evaluator's Signature ________________ Date ________________

DUTY: MAINTAINING AND SERVICING DIESEL FUEL SYSTEM

PERFORMANCE OBJECTIVE V-TECS 88

TASK: Service the diesel injector pump.

STANDARD OF PERFORMANCE OF TASK:
Service the specified diesel- injection pump for minor adjustments. Set timing to the manufacturer's specifications and get within 5% of the manufacturer's specifications of the high and low idle, as checked by the instructor.

SOURCE OF STANDARD:
Kentucky Writing Team - Supervisor.

CONDITIONS FOR PERFORMANCE OF TASK:
Given wrenches to fit bolts encountered, a strobe-light tachometer and other special tools to check timing for the pump, service a diesel injector pump for minor adjustments.

ENABLING OBJECTIVE(S):

1. Use of hand tools.
2. Ability to read.

RESOURCES:

1. Tractor manufacturer's manual.
2. Operators manual for strobe-light tachometer.

TEACHING ACTIVITIES:

1. Explain the function of injector pumps.
2. Demonstrate use of tools to service injector pump.
3. List the problems which an improperly timed injector pump can cause.
4. Demonstrate the proper procedure for performing minor service on an injector pump.
5. Have students identify the parts of an injector pump.
6. Demonstrate the use of the strobe light tachometer.

CRITERION REFERENCED MEASURE:

Practical Application:
Student will service an injection pump for minor adjustments. Timing will be set within 5% of manufacturer's specifications.

Method of Evaluating Practical Application:
Use checklist for PO #88. Al items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 88 EVALUATION

PERFORMANCE TEST FOR SERVICING THE DIESEL INJECTOR PUMP

Student's Name ______________________ **Date** ______________________

DIRECTIONS TO STUDENT: Service the diesel injector pump. Set timing to within 5% of manufacturer's specifications of the high and low idle. All steps on the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1. Checked the manufacturer's specifications of the engine as to high idle, low idle, and basic engine timing.	________	________
2. Rotated the engine until the correct degree of timing comes up at the flywheel or front pulley.	________	________
3. Removed the plug at the pump or the plate on the pump to see if the timing marks are in line.	________	________
4. If timing marks are not in line, loosened retaining bolts and rotated the pump clockwise or counter clockwise until the marks are exactly in line.	________	________
5. Retightened the pump bolts and started engine.	________	________
6. With a strobe tachometer, took a reading of the engine RPM at low idle, compared with the specifications.	________	________
7. Rotated the low idle stop of the governor control until the correct low idle is reached. Locked the low idle screw down and installed a sealing wire to prevent future movement.	________	________
8. Moved the fuel control lever to high idle and compared the tachometer reading with the manufacturer's specifications.	________	________

PERFORMANCE OBJECTIVE V-TECS 88 CHECKLIST (Continued)

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
9.	Moved the high idle adjustment screw until the manufacturer's recommended setting is reached and locked down with jam nuts. Installed a locking wire to prevent further movement.	________	________
10.	Operated the engine at high idle and checked for loose fittings and leaky lines.	________	________

APPROVED Yes ___ No ___

Evaluator's Signature Date

DUTY: MAINTAINING AND SERVICING DIESEL FUEL SYSTEM

PERFORMANCE OBJECTIVE V-TECS 89

TASK: Service a diesel-transfer pump.

STANDARDS OF PERFORMANCE OF TASK:

Service the diesel-transfer pump on the designated tractor. The removal and reinstallation should meet Roosa-Master specifications for its fuel transfer pump, and the job should take no more than one hour.

SOURCE OF STANDARD:

Kentucky Writing Team - Supervisor.

CONDITIONS FOR PERFORMANCE OF TASK:

Using the designated tractor, a Roosa-Master service manual, screwdrivers, a micrometer, and a torque wrench, service a diesel-transfer pump.

ENABLING OBJECTIVE(S):

1. Use of micrometer.
2. Use of torque wrench.
3. Ability to read.
4. Use of hand tools.

RESOURCES:

1. Tractor manufacturer's manual.
2. Roosa-Master service manual.

TEACHING ACTIVITIES:

1. Discuss diesel transfer pumps, function and purpose.
2. Identify parts of diesel transfer pump.
3. Explain use of Roosa-Master tools.
4. Explain use of micrometer and torque wrench.
5. Demonstrate proper procedure for servicing diesel transfer pump.
6. Have student list the steps in servicing a diesel transfer pump.

CRITERION REFERENCED MEASURE:

Practical Application:

The student will service the diesel transfer pump. The job should be completed in one hour or less and meet Roosa-Master specifications.

Method of Evaluating Practical Application:

Use checklist for PO #89. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 89 EVALUATION

PERFORMANCE TEST FOR SERVICING A DIESEL TRANSFER PUMP

Student's Name **Date**

DIRECTIONS TO STUDENT: Service a diesel transfer pump. The servicing should be completed in one hour or less and meet Roosa-Master specification. All steps on the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Cleaned pump and work area completely.		
2.	Removed hydraulic head assembly.		
3.	Removed end plate.		
4.	Removed the end plate seal.		
5.	Removed the sleeve.		
6.	Removed priming by-pass spring at the bottom of the sleeve bore.		
7.	Removed the transfer pump seal O-Ring.		
8.	Removed the transfer pump liner from the pump. Removed pump blades.		
9.	Washed transfer pump in clean fuel oil.		
10.	Checked pump liner and blades for scratches.		
11.	If they are in one piece, measured blades with a micrometer (minimum width is 1.0930") - if not correct, replaced, both blades.		
12.	Inserted priming by-pass spring into end plate.		
13.	Placed plunger in end plate sleeve and shook to be sure plunger is free to move in bore.		
14.	Inserted sleeve into end plate.		
15.	Assembled regulating spring into bore; installed end plate plug and tighten.		
16.	Washed transfer pump liner and placed in position.		
17.	Inserted blades carefully with one vertical and the other horizontal.		
18.	Installed end plate sealing ring.		

PERFORMANCE OBJECTIVE V-TECS 89 CHECKLIST (Continued)

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
19.	Turned liner so that notched slot will align with roll in end plate assembly, and installed end plate assembly.		
20.	Inserted screws and tightened to 36-39 in. lbs.		
21.	Reinstalled fuel lines and bled system.		
22.	Checked fuel pump pressure.		

APPROVED Yes ___ No ___

Evaluator's Signature Date

DUTY: MAINTAINING AND SERVICING DIESEL FUEL SYSTEM

PERFORMANCE OBJECTIVE V-TECS 90

TASK: Service turbochargers.

STANDARD OF PERFORMANCE OF TASK:
Replace or reinstall the turbocharger on the designated tractor. Replaced or reinstalled unit should meet manufacturer's specifications and all points of the instructor's checklist.

SOURCE OF STANDARD:
Kentucky Writing Team - Supervisor.

CONDITIONS FOR PERFORMANCE OF TASK:
Using the designated tractor and service manual, a set of mechanic's tools, a gasket scraper, torque wrench, and dial indicator with plunger extension, service a turbocharger.

ENABLING OBJECTIVE(S):

1. Knowledge of safety practices.
2. Ability to read.
3. Service manual.
4. Use of hand tools.

RESOURCES:

1. Operator's manual for tractor.
2. Service manual.
3. Operator's manual for dial indicator.

TEACHING ACTIVITIES:

1. Discuss shop safety.
2. Discuss and demonstrate function of a turbocharger.
3. Demonstrate use of dial indicator.
4. Demonstrate proper removal, servicing and installation of turbocharger.
5. Have students perform the task of removing and reinstalling turbocharger.

CRITERION REFERENCED MEASURE:

Practical Application:
Remove and reinstall turbocharger.

Method of Evaluation:
Use the checklist for PO #90. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 90 EVALUATION

PERFORMANCE TEST FOR SERVICING TURBOCHARGER

Student's Name **Date**

DIRECTIONS TO STUDENT: Replace or reinstall the turbocharger. Replaced or reinstalled unit must meet manufacturer's specifications. All steps on the checklist will be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Removed turbocharger.	___	___
2.	Cleaned manifold connection.	___	___
3.	Inspected blades.	___	___
4.	Checked radial bearing play.	___	___
5.	Checked shaft end play.	___	___
6.	Reinstalled turbocharger.	___	___
7.	Checked all connections.	___	___

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING DIESEL FUEL SYSTEM

PERFORMANCE OBJECTIVE V-TECS 91

TASK: Time fuel injector pump to engine.

STANDARD OF PERFORMANCE OF TASK:
Time a fuel injector pump on the designated tractor engine. The reinstalled pump will be timed to within one-half of a degree of the specifications given in the operator's manual and the teacher's reading.

SOURCE OF STANDARD:
Kentucky Writing Team - Supervisor.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a tractor engine, necessary wrenches, and service manual, time the fuel injector pump on the engine.

ENABLING OBJECTIVE(S):

1. Know shop safety practices.
2. Ability to read.
3. Use of hand tools.

RESOURCES:

1. Operator's manual for designated tractor.
2. Service manual.

TEACHING ACTIVITIES:

1. Discuss shop safety.
2. Discuss importance and function of timing.
3. Demonstrate timing a fuel-injector pump.
4. Have students discuss importance of correct timing.
5. Have students time a fuel injector pump on the designated tractor.

CRITERION REFERENCED MEASURE:

Practical Application:
Time a fuel injector pump on the designated tractor engine. The reinstalled pump will be timed to within one-half of a degree of the specifications.

Method of Evaluating Practical Application:
Using the checklist for PO #91. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 91 EVALUATION

PERFORMANCE TEST FOR TIMING A FUEL INJECTOR PUMP

Student's Name **Date**

DIRECTIONS TO STUDENT: Time the fuel injector pump on the designated tractor engine. Pump must be timed to within one-half of a degree of the specifications given in the operator's manual and the teacher's reading. All steps on checklist must be completed.

DIRECTIONS TO STUDENT: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Checked manufacturer's specifications for timing of make and model of tractor.		
2.	Removed No. 1 injector to make sure cylinder on compression stroke.		
3.	Rotated engine to line up timing mark on flywheel.		
4.	Aligned pump timing mark and rotated pump gear properly.		
5.	Installed pump and retaining cap screws.		
6.	Rotated pump in slotted hole to align timing marks.		
7.	Properly torqued cap screws.		
8.	Bled fuel system.		
9.	Started engine and checked for leaks.		

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

MAINTAINING AND SERVICING BASIC ENGINE

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 92

TASK: Adjust valve clearance.

STANDARD OF PERFORMANCE OF TASK:
Adjust the valves on the designated tractor. The valves should be adjusted to the manufacturer's specifications.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist

CONDITIONS FOR PERFORMANCE OF TASK:
Using the designated tractor, a mechanic's tool set, tappet wrench, service manual, and a crank, adjust the valve clearance.

ENABLING OBJECTIVE(S):

1. Knowledge of 4 cycle engine.
2. Ability to read.
3. Use of hand tools.

RESOURCES:

1. AAVIM, **Tractor Maintenance,**. pp. 45 - 54.
2. Phipps, **Mechanics in Agriculture,** pp. 372-375.e

TEACHING ACTIVITIES:

1. List the procedure used in adjusting the valve clearance correctly.
2. Describe why adjusting valve clearance improves engine performance and prolongs engine life.
3. List the parts of the tractor which must be removed in order to adjust valve clearance.
4. List safety steps in working on tractors.
5. Identify the parts of the valve system.
6. Demonstrate the proper procedure for adjusting the valves clearance using feeler gauge.
7. Apply the proper procedure for installing new valve cover gasket when putting valve cover back on.

CRITERION REFERENCED MEASURE:

Questions:

1. List the steps used in adjusting valves.
2. Explain why valve clearance adjustment improves engine performance.

Answers:

1. a. Read your operator's manual to determine whether you should check valve clearances while the engine is hot or cold.
   b. Clean and remove valve cover.

PERFORMANCE OBJECTIVE V-TECS 92 (Continued)

Criterion Referenced Measure Continued:

c. Disconnect coil wire.
d. Check cylinder head for tightness.
e. Slowly turn crankshaft until piston in No. 1 cylinder is at top dead center of compression stroke.
f. Select proper thickness of feeler gauge.
h. Check clearance by inserting gage between valve stem and rocker arm of both valves.
i. Loosen adjustment screw on rocker arm.
j. Turn adjustment screw until feeler gage will just slip in and out of gap.
k. Hold adjusting screw with a screwdriver and tighten lock nut.
l. Adjust other cylinder valve. Use same procedure as for #1 cylinder.

2. Valve gives longer service.
Engine uses fuel more efficiently.
Engine starts more easily.
Maximum power is produced.
Engine is less likely to overheat.
Smoothest engine operation is provided.

Practical Application:
The student will adjust valve clearance to the manufacturer's specifications.

Method of Evaluating Practical Application:
Use the checklist for PO #92. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 92 EVALUATION

PERFORMANCE TEST FOR ADJUSTING VALVE CLEARANCE

Student's Name **Date**

DIRECTIONS TO STUDENT: Using the designated tractor, a mechanic's tool set, tappet wrench, service manual, and a crank, adjust the valve clearances to manufacturer's specifications. All steps on checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Checked manufacturer's specifications.	______	______
2.	Cranked engine to bring number one piston to T.D.C. on compression stroke.	______	______
3.	Adjust both intake and exhaust valve with feeler gauge to manufacturer's specifications.	______	______
4.	Did each cylinder in order, repeated steps 1-3 for each cylinder.	______	______
5.	Reinstalled valve cover.	______	______

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 93

TASK: Check cylinder head and block for warpage.

STANDARD OF PERFORMANCE OF TASK:
Check the cylinder head and engine block for warpage on the designated tractor. All excessive warpage must be marked.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a cylinder head and block, a straight edge, and a feeler gauge, check cylinder head and block for warpage.

ENABLING OBJECTIVE(S):

1. Ability to use feeler gauge.
2. Use hand tools.

RESOURCES:

1. Jacobs/Harrell, **Agricultural Power and Machinery**, pp. 248-249.

TEACHING ACTIVITIES:

1. Define what is cylinder head and engine block warpage.
2. List cause for cylinder head and block warpage.
3. Check reference books for recommended sequence tightening and torque for cylinder head.
4. Explain the steps in removing cylinder head.
5. Demonstrate how to check head and block for warpage.
6. Check and replace, if necessary, head gasket.

CRITERION REFERENCED MEASURE:

Questions:

1. What causes cylinder head and block warpage?

Answers

1. Overheating and head bolts not being torqued to specification or not torqued in proper sequence.

Practical Application:

The student will check cylinder head and engine block for warpage. All excessive warpage will be marked.

Method of Evaluating Practical Application:

Use the checklist for PO #93. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 93 EVALUATION

PERFORMANCE TEST FOR CHECKING CYLINDER HEAD AND BLOCK FOR WARPAGE

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a cylinder head and block, a straight edge and a feeler gauge, check cylinder head and block for warpage and mark all excessive warpage. All steps on checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Removed and cleaned head.	________	________
2.	Laid straight edge across the head and checked clearance with feeler gauge.	________	________
3.	Checked mating surface of the block.	________	________
4.	Marked all excessive warpage.	________	________

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 94

TASK: Clean cylinder block, oil passages, and piston.

STANDARD OF PERFORMANCE OF TASK:
Clean the cylinder block, oil passages, and piston on the designated tractor. Upon visual inspection all parts of the cylinder block, oil passages, and piston will be clean and there will be no significant damage to any parts.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a parts cleaning tank, clean the cylinder block, oil passages, and pistons on a tractor.

ENABLING OBJECTIVE(S):

1. Ability to use air compressor.
2. Use steam cleaner.
3. Use of hand tools.

RESOURCES:

1. Jacobs/Harrell, **Agriculture Power and Machinery**, p. 237.

TEACHING ACTIVITIES:

1. List safety steps in disassembling an engine and using cleaning agents and equipment.
2. Prepare engine for disassembly by cleaning outside parts of the engine with steam cleaner.
3. Compare a properly cleaned cylinder block with a block that is improperly cleaned.
4. Identify all oil and water passages and other parts of the block.
5. Demonstrate how to clean a cylinder block.
6. Demonstrate removal of cylinder head from the block and remove the block from the tractor frame.

CRITERION REFERENCED MEASURE:

Questions:

1. Name causes of blocked passages in a block.
2. List preventive maintenances that will help to control sludge from forming in the block.

Answers:

1. a. Using wrong oil classifications.
   b. Using oil too long between changes.
   c. Overheating of oil.
2. Oil change at regular interval.

PERFORMANCE OBJECTIVE V-TECS 94 (Continued)

Criterion Referenced Measure Continued:

Practical Application:
The student will clean cylinder block, oil passages and piston. All will have no visual damage and be clean on inspection.

Method of Evaluating Practical Application:
Use the checklist for PO #94. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 94 EVALUATION

PERFORMANCE TEST FOR CLEANING CYLINDER BLOCK, OIL PASSAGES AND PISTON

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a parts cleaning tank, clean cylinder block, oil passages and pistons on a tractor. There must be no damage to parts and it must be clean upon visual inspection. All steps on checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Put on safety equipment.	____	____
2. Washed all mechanical parts.	____	____
3. Removed dirt and carbon deposits from head, block, and piston.	____	____
4. Blew out all oil passages with compressed air.	____	____

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 95

TASK: Deglaze cylinder.

STANDARD OF PERFORMANCE OF TASK:
Deglaze cylinder on the designated tractor. No abrasive will be allowed to come in contact with the crank shaft and the honing must be adequate to remove most glaze.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANC OF TASK:
Given a cylinder and a cylinder hone, deglaze a cylinder.

ENABLING OBJECTIVE:

1. Use of hand tools.

RESOURCES:

1. Jacobs/Harrell, **Agricultural Power and Machinery**, p. 281.

TEACHING ACTIVITIES:

1. Identify tools needed to hone a cylinder.
2. List safety procedure used when honing a cylinder.
3. Describe why it is necessary to deglaze a cylinder.
4. Prepare engine block for honing by removing all parts from the block which would be in the way or could be damaged during the honing process.
5. Demonstrate how to correctly hone a cylinder.
6. Explain the reasons why it is necessary to thoroughly clean the block after honing.

CRITERION REFERENCED MEASURE:

Questions:

1. Why is it necessary to hone a cylinder?
2. Why is it important to remove all abrasive material after honing?

Answers:

1. For proper ring seating.
2. The abrasive materials get in oil and can damage cylinder walls and crankshaft and oil pump.

Practical Application:

The student will deglaze a cylinder, honing will remove most glaze.

Method of Evaluating Practical Application:

Use the checklist for PO# 95. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 95 EVALUATION

PERFORMANCE TEST FOR DEGLAZING CYLINDER

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a cylinder and a cylinder hone, deglaze a cylinder. Honing must be adequate to remove most glaze. All steps on checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Removed pistons, covered crankshaft.	______	______
2.	Adjusted cylinder hone to fit cylinder.	______	______
3.	Oiled hone lightly.	______	______
4.	Moved hone up and down cylinder to produce cross-hatch pattern.	______	______
5.	Checked often to guard against over honing.	______	______
6.	Checked and removed all abrasive material. Use hot water and detergent.	______	______

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 96

TASK: Grind valves.

STANDARD OF PERFORMANCE OF TASK:
Grind the valves removed from the designated tractor so they mate perfectly with their seat.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a mechanic's tool set, a valve spring compressor, and valve grinding machine, grind the valves.

ENABLING OBJECTIVE(S):

1. Ability to use hand tools.
2. Ability to read.
3. Ability to use micrometer and/or caliper.

RESOURCES:

1. Jacobs/Harrell, **Agricultural Power and Machinery**, pp. 246-248.

TEACHING ACTIVITIES:

1. Demonstrate how to measure the valve face and stem.
2. Identify the correct valve angle by looking up manufacturer's specifications.
3. List steps in grinding valve.
4. Remove valves from tractor head and place valve in order removed and explain why this is important.
5. Demonstrate how to grind valve.
6. Demonstrate the proper procedure for lapping valve with valve seat.
7. Identify the proper lapping compound for lapping valves.
8. Explain why the head must be cleaned after lapping.

CRITERION REFERENCED MEASURE:

Questions:

1. Explain why valve face angle is important in proper engine operation.
2. List the reasons why a valve may not seat correctly.

Answers:

1. For proper valve seating.
2. a. Burn or warpage of valve.
   b. Improper valve and rocker arm clearance.

PERFORMANCE OBJECTIVE V-TECS 96

Practical Application:
The student will guide valves so they mate perfectly with the seat.

Method of Evaluating Practical Application:
Use the checklist for PO #96. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 96 EVALUATION

PERFORMANCE TEST FOR GRINDING VALVE

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a mechanic's tool set, a valve spring compressor, and valve grinding machine, grind the valves so that they mate perfectly with their seat. All steps on the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Removed cylinder head.	______	______
2.	Removed valve springs and keeper.	______	______
3.	Removed valves keeping them in order.	______	______
4.	Checked valve stem and guides for wear.	______	______
5.	Ground each valve to specified face angle.	______	______
6.	Lapped valve to its seat, removed all traces of lapping compound.	______	______
7.	Reinstalled valve springs and keepers and head.	______	______
8.	Adjusted valves.	______	______

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 97

TASK: Install connecting rods caps.

STANDARD OF PERFORMANCE OF TASK:
Install connecting rod caps on the designated tractor. The bearing will be properly seated as specified in the service manual.

SOURCE OF STANDARD:
Kentucky Writing Team - Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a mechanic's tool set, service manual, micrometers, plastigauge, and a soft face hammer, install connecting rod caps on the designated tractor.

ENABLING OBJECTIVE(S):

1. Ability to use micrometer.
2. Ability to read.
3. Use of hand tools.

RESOURCES:

1. Jacobs/Harrell, **Agricultural Power and Machinery**, p. 254.
2. Tractor manufacturer's service manual.

TEACHING ACTIVITIES:

1. List parts which must be removed to make piston and crankshaft accessible.
2. Explain the reasons for using a soft faced hammer.
3. Discuss the reasons for crankshaft wear.
4. Demonstrate rod cap and bearing insert removed.
5. Demonstrate use of plastigauge.
6. Identify a worn bearing, and discuss the causes of wear.
7. Demonstrate installation of new inserts using a torque wrench.

CRITERION REFERENCED MEASURE:

Questions:

1. Why is it important to use plastigauge when installing rod caps?
2. Why is it important to lubricate bearings before tightening rod caps?

Answers:

1. Plastigauge will tell if there is correct clearance between rod cap and crankshaft bearings.
2. To prevent bearing from over heating and causing wear during start-up before oil pump has time to deliver oil to bearings.

PERFORMANCE OBJECTIVE V-TECS 97

Criterion Referenced Measure:

Practical Application:
The student will install connecting rod caps as specified in the service manual.

Method of Evaluating Practical Application:
Use checklist for PO #97. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 97 EVALUATION

PERFORMANCE TEST FOR INSTALLING CONNECTING RODS CAPS

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a mechanic's tool set, service manual, micrometer, plastigauge, and a soft face hammer install connecting rod caps on the designated tractor.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Removed all parts to make piston and crankshaft accessible.		
2.	Unbolted rod cap. Knocked cap loose with a soft face hammer.		
3.	Pushed rod away from crankshaft.		
4.	"Mic" Journal for excess wear.		
5.	Pried insert from rod and rod cap.		
6.	Installed new inserts.		
7.	Oiled bearing lightly.		
8.	Reseated rod on crankshaft journal.		
9.	Reinstalled rod cap.		
10.	Torqued to specification.		
11.	Removed cap and place a strip of "plastigauge" across the insert.		
12.	Rinstalled cap and torque to specification.		
13.	Removed cap and measured plastigauge width using card that comes with plastigauge.		
14.	If clearance is within specified limits, cleaned journal and reinstalled cap.		
15.	Bent up lock tabs or installed lock wires.		
16.	Reassembled engine.		

APPROVED Yes ___ No ___

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 98

TASK: Install a crankshaft.

STANDARD OF PERFORMANCE OF TASK:
In the shop area, install a crankshaft on the designated tractor. All steps on the instructor's checklist will be completed.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a mechanic's tool set and plastigauge, install a crankshaft on the designated tractor.

ENABLING OBJECTIVE(S):

1. Be able to use plastigauge.
2. Ability to use a feeler gauge.
3. Use of hand tools.

RESOURCES:

1. Jacobs/Harrell, **Agricultural Power and Machinery,** pp. 281-282.

TEACHING ACTIVITIES:

1. Demonstrate to students how to examine the old crank shaft and how to measure it with micrometer to determine if it needs replacing.
2. Discuss with student the proper lubricant to lubricate the new part with.
3. Have student list all tools and equipment needed to perform the task.
4. Discuss with student why it is necessary to keep parts in order and to identify each part.
5. Explain why it is important to check each rod bearing cap and main bearing for proper clearance.
6. Demonstrate the replacement of crankshaft and pistons.

CRITERION REFERENCED MEASURE:

Questions:
True or False

1. It is not important to replace parts back in the same place when installing a crankshaft.
2. When installing a crankshaft it is important to check for binding.

Answers:

1. False
2. True

Practical Application:
The student will install a crankshaft to the manufacturer's specification.

Method of Evaluating Practical Application:
Use the checklist for Performance Objective 98. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 98 EVALUATION

PERFORMANCE TEST FOR INSTALLING A CRANKSHAFT

Student's Name **Date**

DIRECTIONS TO STUDENT: Install a crankshaft. All steps on the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Installed main bearing inserts.	______	______
2. Installed main cap inserts.	______	______
3. Torqued and installed main caps.	______	______
4. Identified clearance using plastigauge.	______	______
5. Installed pistons and rods.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 99

TASK: Install cylinder heads.

STANDARD OF PERFORMANCE OF TASK:
Install cylinder head on the designated tractor. All parts should be installed with no visible leaks and torqued to service manual specifications.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a mechanic's tool set and service manual, install a cylinder head on the designated tractor.

ENABLING OBJECTIVE(S):

1. Ability to clean block and head.
2. Ability to grind and seat valves.
3. Use of hand tools.

RESOURCES:

1. Jacobs/Harrell, **Agricultural Power and Machinery,** p. 286.

TEACHING ACTIVITIES:

1. Discuss with students the functions that the cylinder head performs.
2. Demonstrate to students how to examine the head for cracks or other signs of damage.
3. Demonstrate to students how to examine the old head gasket to check for oil leaks or water leakage.
4. Discuss with students the importance of head bolt tightening sequence.
5. Demonstrate the task of installing a cylinder head.

CRITERION REFERENCED MEASURE:

Questions:
True or False

1. Torquing head bolts means running them up hand tight.
2. Cylinder head are very study so dropping it will cause no problems.

Answers:

1. False
2. False

Practical Application:
The student must install a cylinder head.

Method of Evaluating Practical Application:
Use the checklist for Performance Objective 99. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 99 EVALUATION

PERFORMANCE TEST FOR INSTALLING CYLINDER HEADS

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a mechanic's tool set and service manual, install a cylinder head on the designated tractor.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Installed new head gasket.	______	______
2. Installed head bolts hand tight.	______	______
3. Used sequence and torqued head bolts.	______	______
4. Reassembled remainder of engine and adjust valves.	______	______
5. Re-torqued head after few hours of light duty operation.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 100

TASK: Install front oil seals.

STANDARD OF PERFORMANCE OF TASK:
Install front oil seals in the designated tractor. The seal will be fully installed in a clean bore and correctly fitted around crankshaft. All parts will be reinstalled in good order with no leaks present.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a mechanic's tool set and a seal driver, install front oil seal.

ENABLING OBJECTIVE(S):

1. Ability to assemble engine.
2. Ability to use hand tool.

RESOURCES:

1. Jacobs/Harrell, **Agricultural Power and Machinery,** pp. 276-289.

TEACHING ACTIVITIES:

1. Discuss the purposes for seals.
2. Demonstrate to students how to identify worn oil seals.
3. Demonstrate to students how to replace oil seal.
4. Discuss with students the reasoning for replacing seals when overhauling an engine even if it does not leak.
5. Have students list the parts in order that he or she removes when replacing the seal.
6. Explain why you lubricate a seal with engine oil after the seal has been seated.

CRITERION REFERENCED MEASURE:

Question:
True or False

1. All seals should be coated with oil before installing.

Answer:

1. True

Practical Application:
The student will install a front oil seals.

Method of Evaluating Practical Application:
Use the checklist for Performance Objective 100. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 100 EVALUATION

PERFORMANCE TEST FOR INSTALLING FRONT OIL SEALS

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a mechanic's tool set and a seal driver, install front oil seal.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Removed timing chain cover.	______	______
2. Removed old seal from cover.	______	______
3. Applied light coat of sealing compound to outer surface of new seal.	______	______
4. Drove seal in place.	______	______
5. Reinstalled timing cover; torqued bolts to specification.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature Date

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 101

TASK: Install main bearings and caps.

STANDARD OF PERFORMANCE OF TASK:
In the shop area, install main bearings and caps on the designated tractor. All main cap bolts should be torqued and clearances measured to manufacturer's specifications.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist

CONDITIONS FOR PERFORMANCE OF TASK:
Given bearings and caps, a mechanic's tool set, service manual, and engine oil, install main bearings and caps on the designated tractor.

ENABLING OBJECTIVE(S):

1. Be able to use plastigauge.
2. Ability to use torque/wrench and read service manual.
3. Use of hand tools.

RESOURCES:

1. Jacobs/Harrell, **Agricultural Power and Machinery,** p. 282.

TEACHING ACTIVITIES:

1. Demonstrate to students how to identify signs of wear on main bearings and rod bearing inserts.
2. Show students how to look up in the service manual allowable tolerance and how to make recommendations for type of inserts, over- or under sized insert, after measurements are made with plastigauge on main bearings.
3. Have students list the steps used in correctly installing main and rod bearing.
4. Have students clean and check crankshaft for signs of wear and make recommendations for corrections.
5. Demonstrate the correct procedure for installing main bearing and rod bearings.
6. Have students read chapter 16 in **Agricultural Power and Machinery** by Jacobs/Harrell.

CRITERION REFERENCED MEASURE:

Questions:
True or False

1. Inserts come in at least three sizes.
2. You check bearing clearance with plastigauge.

Answers:

1. True
2. True

PERFORMANCE OBJECTIVE V-TECS 101 (Continued)

Practical Application:

The student will install main bearings and caps to manufacturer's specifications.

Method of Evaluating Practical Application:

Use checklist for Performance Objective 101. All steps must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 101 EVALUATION

PERFORMANCE TEST FOR INSTALLING MAIN BEARINGS AND CAPS

Student's Name **Date**

DIRECTIONS TO STUDENT: Install main bearings and caps on the designated tractor. All main cap bolts should be torqued and clearances measured to manufacturer's specification.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1.	Removed main bearings and rod bearings.	______	______
2.	Installed inserts in block and main bearing.	______	______
3.	Installed new main and rod bearings.	______	______
4.	Lubricated inserts with engine oil.	______	______
5.	Checked clearance with plastigauge.	______	______
6.	Corrected with over or undersized insert if not meeting specifications.	______	______
7.	Installed rod assembly, checked each for proper clearance with plastigauge.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 102

TASK: Install piston assembly

STANDARD OF PERFORMANCE OF TASK:
Install a piston assembly in the designated tractor. The piston will be installed without any damage to any part of the engine.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a mechanic's tool set and piston ring compressor, install a piston assembly in the designated tractor.

ENABLING OBJECTIVE(S):

1. Ability to use plastigauge and micrometer.
2. Ability to read service manual.
3. Knowledge of shop safety.
4. Use of hand tools.

RESOURCES:

1. Jacobs/Harrell. **Agricultural Power and Machinery,** pp. 276-288.

TEACHING ACTIVITIES:

1. List with students the reasons for piston removal and causes for these problems.
2. Demonstrate to students how to install piston on connecting rod.
3. Demonstrate to students proper installation of piston rings.
4. Demonstrate to students how to measure each cylinder for using gap clearance by inserting a ring and measuring the gap with a feeler gauge and checking manufacturer's specifications for proper gap clearance.
5. Explain to students the types of engine damages caused by improper piston assembly and installation.

CRITERION REFERENCED MEASURE:

Questions:
True or False

1. The piston assembly consists of the piston, piston ring, rod, and rod cap.
2. It is okay to drive a piston in with a ball-peen hammer.

Answers:

1. True
2. False

Practical Application:
The student will install piston assembly.

Method of Evaluating Practical Application:
Use checklist for Performance Objective 102. All steps must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 102 EVALUATION

PERFORMANCE TEST FOR INSTALLING PISTON ASSEMBLY

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a mechanic's tool set and piston ring compressor install a piston assembly in the designated tractor.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1. Tightened ring compressor on piston and rings.	______	______
2. Placed piston in cylinder being sure the correct side faces front.	______	______
3. Tapped piston down into cylinder with block of wood on soft-faced hammer.	______	______
4. Installed bearing inserts and rod cap.	______	______
5. Torqued rod cap bolts to correct specification.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 103

TASK: Install rear main oil seals.

STANDARD OF PERFORMANCE OF TASK:
Install a rear main oil seal on the designated tractor. The new seal will be correctly placed and will hold oil. Other parts will be correctly placed and tightened.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a mechanic's tool set, a torque wrench, a new gasket, and a seal, install rear main oil seal.

ENABLING OBJECTIVE(S):

1. Ability to use hand tools and torque wrench.
2. Use shop safety.

RESOURCES:

1. Jacobs/Harrell. **Agricultural Power and Machinery,** pp. 276-288.

TEACHING ACTIVITIES:

1. Identify the two types of oil seals that are used.
2. Explain the causes of oil seal leakage.
3. List safety procedures needed when removing oil pan.
4. Demonstrate how to correctly replace the rear main oil seals.
5. Explain why you must remove all of the old oil pan gasket.

CRITERION REFERENCED MEASURE:

Question:
True or False

1. To install the rear main oil seals the oil pan must be removed.

Answer:

1. True

Practical Application:
The student will install rear main oil seals.

Method of Evaluating Practical Application:
Use the checklist for Performance Objective 103. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 103 EVALUATION

PERFORMANCE TEST FOR INSTALLING REAR MAIN OIL SEALS

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a mechanic's tool set, a torque wrench, a new gasket, and a seal, install rear main oil seal.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1.	Removed oil pan and cleaned.		
2.	Removed old oil pan gasket from block.		
3.	Removed rear main bearing cap.		
4.	Pulled out old seal.		
5.	Coated outside of new seal with sealing compound.		
6.	Lubricated lip of seal with engine oil.		
7.	Put rear main cap (with seal) in place.		
8.	Torqued main bearings to specifications.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 104

TASK: Install rod bearings.

STANDARD OF PERFORMANCE OF TASK:
Install rod bearings on the designated tractor. The rod bearings will be properly seated. All bearings will be torqued and clearance checked as specified in service manual.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a complete mechanic's tool set, service manual, micrometers, plastigauge, and a soft-faced hammer, install rod bearings on the designated tractor.

ENABLING OBJECTIVE(S):

1. Use of mechanics tools.
2. Knowledge of shop safety.

RESOURCES:

1. Jacobs/Harrell. **Agricultural Power and Machinery,** pp. 242-252.

TEACHING ACTIVITIES:

1. Demonstrate to students the removal of the oil pan and the cleaning of all parts that are exposed.
2. Have students list the reasons for crankshaft and insert wear.
3. Demonstrate to students how to "mic" each journal and record readings.
4. Have students read chapter 14 in **Agricultural Power and Machinery** by Jacobs/Harrell.
5. Demonstrate to students how to place plastigauge inside each rod bearing and torque each bearing and check and record each reading.
6. Have students list the recommendations for correction if measurements do not meet specification.

CRITERION REFERENCED MEASURE:

Question:
True of False

1. "Mic" the journal for wear means looking at it under bright lights.

Answer:

1. False

Practical Application:
The student will install rod bearing to proper clearance specification.

Method of Evaluating Practical Application:
Use the checklist for Performance Objective 104. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 104 EVALUATION

PERFORMANCE TEST FOR INSTALLING ROD BEARING

Student's Name **Date**

DIRECTIONS TO STUDENT: Install rod bearing on the designated tractor. The rod bearings will be properly seated. All bearings will be torqued and clearance checked as specified by service manual.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Unbolted and jarred loose rod cap.	______	______
2.	Removed and marked each cap.	______	______
3.	"Mic" journal for excessive wear.	______	______
4.	Installed new inserts and oiled lightly.	______	______
5.	Used plastigauge and torqued rod cap bolts and measured plastigauge with card.	______	______
6.	If within specified limit cleaned and installed cap, lubricated, and torqued rod cap.	______	______

APPROVED: Yes _____ No ______

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 105

TASK: Install timing chain or gears.

STANDARD OF PERFORMANCE OF TASK:
Install a timing chain or gears on the designated engine. All parts will be assembled in correct order and the timing will be to manufacturer's specifications.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a timing gear or chain, a mechanic's tool set, service manual, and pullers for the engine being worked on, install the timing gear or chain on the designated tractor.

ENABLING OBJECTIVE(S):

1. Use of hand and special tools.
2. Knowledge of shop safety.
3. Ability to read service manual.

RESOURCES:

1. Jacobs/Harrell. **Agricultural Power and Machinery,** pp. 276-288.

TEACHING ACTIVITIES:

1. Have students list all parts of the valve train.
2. Discuss with students what is meant by timing an engine.
3. Explain the role of the timing chain and gear in the process of timing the engine.
4. Demonstrate how to tell if a gear or timing chain shows wear.
5. Demonstrate the replacement of the timing chain or gear.
6. Demonstrate how to align the gears before putting on the chain.

CRITERION REFERENCED MEASURE:

Questions:
True or False

1. Timing an engine means timing the spark to the opening and closing of the valves.
2. Timing chains will wear some due to not changing the oil on a regular basis.

Answers:

1. True
2. True

Practical Application:
The student will install timing chain and/or gears and time engine to manufacturer's specification.

Method of Evaluating Practical Application:
Use checklist for Performance Objective 105. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 105 EVALUATION

PERFORMANCE TEST FOR INSTALLING TIMING CHAIN OR GEARS

Student's Name **Date**

DIRECTIONS TO STUDENT: Install timing chain or gear. All parts will be assembled in correct order and the timing will be to manufacturer's specifications.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Removed timing chain or gear cover.		
2. Cranked engine and observe alignment marks.		
3. Unbolted chainshaft gear (sprocket).		
4. Pulled gear (sprocket).		
5. Reassembled and installed timing chain/gear with timing mark correctly aligned.		
6. Reassembled other parts.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 106

TASK: Measure bearing clearance.

STANDARD OF PERFORMANCE OF TASK:
In the shop area, measure the bearing clearance on a designated tractor. The measurement must agree with the instructor's measurement.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a mechanic's tool set, micrometers, plastigauge, and a soft-faced hammer, measure the bearing clearance.

ENABLING OBJECTIVE(S):

1. Ability to use micrometer and plastigauge.
2. Use of hand tools.

RESOURCES:

1. Jacobs/Harrell. **Agricultural Power and Machinery,** pp. 264-275.

TEACHING ACTIVITIES:

1. Demonstrate to students the removal of all parts to make rod cap and crankshaft accessible.
2. Have students list reasons for measure bearing clearance.
3. Have student read Chapter 15, **Agricultural Power and Machinery,** by Jacobs/Harrell, pp. 264-265.
4. Discuss with students the importance of lining up the rod cap with the correct rod.
5. Define tolerance.
6. Explain to students the reason correct torquing of the rod bolts is a must to get a correct measurement with the plastigauge.
7. Demonstrate the use of plastigauge to measure bearing clearance.

CRITERION REFERENCED MEASURE:

Question:
True or False

1. Bearing clearance can be checked by using an outside micrometer.

Answer:

1. False

Practical Application:
The student will measure the bearing clearance.

Method of Evaluating Practical Application:
The student measurements must agree with the instructor's measurement.

PERFORMANCE OBJECTIVE V-TECS 106 (Continued)

PERFORMANCE GUIDE

1. Remove all parts necessary to make pistons, crankshaft and bearings accessible.
2. Remove cap and place a piece of plastigage across the insert.
3. Remove cap and torque to specifications.
4. Remove cap and measure plastigage width using card that comes with plastigage.
5. If clearance is within specified limits, clean plastigage from insert and journal. Lubricate, install and torque rod cap.
6. Bend up lock tabs or install lock wires as required.
7. Reassemble engine.

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 107

TASK: Measure camshaft for wear.

STANDARD OF PERFORMANCE OF TASK:
Measure the camshaft for wear on the designated tractor. All variations from the specifications will be determined.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a complete mechanic's tool set, service manual, and a micrometer, measure the camshaft for wear.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Use of hand tools.

RESOURCES:

1. Jacobs/Harrell. **Agricultural Power and Machinery,** pp. 273-275.

TEACHING ACTIVITIES:

1. Discuss the function of camshaft.
2. List the causes for wear of the camshaft.
3. Demonstrate how to examine the camshaft visually for damage.
4. Explain why you replace the cam bearing before replacing the camshaft.
5. Demonstrate how to measure the camshaft for wear with micrometer.
6. Read chapter 15, **Agricultural Power and Machinery,** pp. 273-275.

CRITERION REFERENCED MEASURE:

Question:
True or False

1. Cam lobe may show wear because the valve was tightened too much.

Answer:

1. True

Practical Application:
The student will measure camshaft for wear at each lobe.

Method of Evaluating Practical Application:
The student's measurement must agree with the instructors.

PERFORMANCE GUIDE:

1. Remove camshaft and inspect visually for obvious damage.
2. Using appropriate micrometer, measure each lobe of the cam and record measurement.
3. Compare your measurement with specifications for the camshaft.
4. Reinstall or replace camshaft as necessary.

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 108

TASK: Measure and record the crankshaft main and rod journals.

STANDARD OF PERFORMANCE OF TASK:
Measure and record the crankshaft main and rod journals on the designated tractor. Recorded measurements should be the same as those of the instructor.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a service manual, micrometer, and a mechanic's tool set, measure and record the crankshaft main and rod journals.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Use of hand tools.

RESOURCES:

1. Jacobs/Harrell. **Agricultural Power and Machinery,** pp. 264-275.

TEACHING ACTIVITIES:

1. List and discuss the reasons for crankshaft wear.
2. Explain the function of the crankshaft.
3. Have students read chapter 15, **Agricultural Power and Machinery,** pp. 270-273.
4. Demonstrate to the students how to check main bearing journals and rod journals for out of round by taking three readings with the correct sized micrometer.
5. Discuss with the students the importance of proper lubrication of inserts when installing a crankshaft.

CRITERION REFERENCED MEASURE:

Question:
True or False

1. Crankshaft rod and main bearing can be measured with an outside micrometer.

Answer:

1. True

Practical Application:
Student will make three measurements and record them for crankshaft main and rod journals.

Method of Evaluating Practical Application:
Student measurement of the main and rod journals will agree with the instructor's readings.

PERFORMANCE OBJECTIVE V-TECS 108 (Continued)

PERFORMANCE GUIDE:

1. With crankshaft removed, clean and visually inspect for obvious damage.
2. Using outside micrometer, make and record three measurements for each bearing journal, one in the middle and one near each end of the journal.
3. Compare your measurements with specifications for the crankshaft.
4. Any significant variation between the three measurements on any one journal indicates uneven wear. Record variations.

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 109

TASK: Measure cylinder taper

STANDARD OF PERFORMANCE OF TASK:
Measure a cylinder taper on the designated tractor. The readings and computations should agree with those of the instructor.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a cylinder and a feeler gauge, measure the cylinder taper.

ENABLING OBJECTIVE(S):

1. Ability to use a feeler gauge and inside micrometer.

RESOURCES:

1. Jacobs/Harrell. **Agricultural Power and Machinery,** pp. 264-275.

TEACHING ACTIVITIES:

1. Discuss the difference in using a ring and feeler gauge and a telescoping micrometer reading to determine cylinder taper.
2. Define cylinder taper.
3. Discuss cause for uneven wear in a cylinder.
4. Demonstrate how to use a ring and feeler gauge to measure cylinder taper.
5. Demonstrate how to use inside micrometer to measure for cylinder taper.
6. Discuss with students how if the taper is not within manufacturer's tolerance, how to solve the problem.

CRITERION REFERENCED MEASURE:

Question:
True or False

1. Cylinder taper refers to the depth a piston travels in a cylinder.

Answer:

1. False

Practical Application:
Student will take at least three measurements inside the cylinder and subtract the smallest from the largest reading and divide by 3.1416 to determine the cylinder taper.

Method of Evaluating Practical Application:
Students answers must agree with instructor's findings.

PERFORMANCE OBJECTIVE V-TECS 109 (Continued)

PERFORMANCE GUIDE:

1. With piston removed, carefully compress a ring and insert it in the cylinder.
2. Be sure the ring is lined up in the cylinder by tapping it down about one inch with the top of an inverted piston.
3. Measure the gap between the ends of the ring with a feeler gauge and record reading. (Cylinder bore gauge or telescoping micrometer may be used).
4. Take readings at one inch intervals down to the lowest point of ring travel.
5. The difference between the largest and smallest readings divided by 3.1416 gives the cylinder taper.

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 110

TASK: Measure piston ring end gap.

STANDARD OF PERFORMANCE OF TASK:
Measure a piston ring end gap in a laboratory setting. Measurement should agree with that of instructor.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a piston ring and feeler gauge, measure the piston ring end gap.

ENABLING OBJECTIVE(S):

1. Ability to use feeler gauge.
2. Ability to read a ruler.

RESOURCES:

1. Jacobs/Harrells. **Agricultural Power and Machinery,** pp. 264-275.

TEACHING ACTIVITIES:

1. Discuss the need to examine the cylinder for cleanliness and smoothness.
2. List and discuss the reasons for measuring piston ring end gap.
3. Discuss what recommendations are made if piston ring end gap does not meet standards.
4. Demonstrate how to measure piston ring end gap.
5. Explain why it is important to take several readings at different intervals down the cylinder.

CRITERION REFERENCED MEASURE:

Question:
True or False

1. The reason for having piston ring end gap is because of expansion of metal when hot.

Answer:

1. True

Practical Application:
The student will take reading at one inch intervals down to the lowest point of ring travel. The smallest reading is the ring end gap.

Method of Evaluating Practical Application:
Students readings for ring end gap must agree with instructor's reading.

PERFORMANCE GUIDE:

1. With piston removed, carefully compress a ring and insert it in the cylinder.
2. Be sure the ring is lined up in the cylinder by tapping it down about one inch with the top of an inverted piston.
3. Measure the gap between the ends of the ring with a feeler gauge, and record reading.
4. Take readings at one inch intervals down to the lowest point of ring travel. The smallest reading is the ring end gap.

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 111

TASK: Measure piston ring land clearance.

STANDARD OF PERFORMANCE OF TASK:
On the designated tractor, measure the piston ring land clearance. The recorded measurements should be the same as that of the instructor.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a piston ring and feeler gauge, measure the piston ring land clearance on the designated tractor.

ENABLING OBJECTIVE(S):

1. Ability to use and read feeler gauge.

RESOURCES:

1. Jacobs/Harrell. **Agriculture Power and Machinery,** pp. 268-269.

TEACHING ACTIVITIES:

1. Define piston ring land clearance.
2. Demonstrate how to remove the piston, clean it, and remove carbon.
3. Discuss the importance of having correct land clearance.
4. Explain the procedure for checking piston ring land clearance.
5. Demonstrate how to check piston ring land clearance.
6. Have students read **Agricultural Power and Machinery,** pp. 268-269.

CRITERION REFERENCED MEASURE:

Question
True or False

1. Piston ring land clearance is the area between the ring and the groove height.

Answer

1. True

Practical Application:
The student will measure piston ring land clearance.

Method of Evaluating Practical Application:
Use checklist for Performance Objective 111. All steps must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 111 EVALUATION

PERFORMANCE TEST FOR MEASURING PISTON RING LAND CLEARANCE

Student's Name **Date**

DIRECTIONS TO STUDENT: Measure the piston land clearance. The recorded instrument should be the same as the instructor.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Cleaned and removed carbon from piston.	____	____
2. Placed ring in ring groove. Held feeler gauge in groove beside the ring and measured clearance.	____	____
3. Rotated piston. Checked measurement around total circumference. Recorded measurement.	____	____
4. Compared measurement with instructor's measurement.	____	____

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 112

TASK: Measure valve stem guide clearance.

STANDARD OF PERFORMANCE OF TASK:
In the laboratory area, measure a valve stem guide clearance. The recorded measurement should be the same as the teacher's measurement.

SOURCE OF STANDARD:
Individual instructor.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a mechanic's tool set and a dial indicator, measure the valve stem guide clearance.

ENABLING OBJECTIVE(S):
1. Ability to use hand tools.

RESOURCES:
1. Jacobs/Harrell. **Agricultural Power and Machinery,** pp. 244-245.

TEACHING ACTIVITIES:
1. Demonstrate through cleaning of engine head.
2. Have students read pages 244-245 in **Agricultural Power and Machinery.**
3. Demonstrate using dial indicator to determine valve stem guide clearance.
4. List the importance of proper valve stem guide clearances.
5. List recommendations to solve improper valve stem guide clearances.

CRITERION REFERENCED MEASURE:

Question
True or False
1. Valve stem guide clearance can be corrected by buying large valve stems or by adding more wall surface to the guide.

Answer
1. False

Practical Application:
The student will measure valve stem guide clearance.

Method of Evaluating Practical Application:
Student measurements must be the same as the instructor's.

PERFORMANCE GUIDE:
1. Develop skill in reading dial indicator.
2. With head removed and valve springs and keepers taken off, connect dial indicator to head with the pickup against the valve stem.
3. With the valve off its seat measure the lateral movement of the valve stem. This is "guide clearance." (The stem and guide must be clean and dry to get an accurate measurement). Record measurement.

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 113

TASK: Reface valve seats.

STANDARD OF PERFORMANCE OF TASK:
Reface the valve seats on the designated tractor, until they mate perfectly with the valves.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a mechanic's tool set, a valve grinding machine, lapping compound, and a tool and valve seat refacing set, reface the valve seats.

ENABLING OBJECTIVE(S):

1. Ability to use inside micrometer.
2. Ability to use valve spring compressor, valve refacer, and seat refacer.
3. Use of hand tools.

RESOURCES:

1. Jacobs/Harrell. **Agricultural Power and Machinery,** pp. 244-250.

TEACHING ACTIVITIES:

1. Discuss and list cause for valve damages.
2. Discuss engine symptoms that would make the mechanic think it would be valve trouble.
3. Discuss and list type of tests that would determine valve trouble.
4. Explain what is meant by lapping.
5. Demonstrate the proper procedure for grinding the valve face to manufacturer's specification.
6. Demonstrate the proper procedure for grinding the valve seat to manufacturer's specification.
7. Show the students how to identify valves that can be refaced and valves that must be rejected.

CRITERION REFERENCED MEASURE:

Practical Application:
The student will reface the valve seat to the manufacturer's specifications.

Method of Evaluating Practical Application:
Use the checklist for Performance Objective 113. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 113 EVALUATION

PERFORMANCE TEST FOR REFACING VALVE SEATS

Student's Name **Date**

DIRECTIONS TO STUDENT: Using the designated tractor, a mechanic's tool set, a valve grinding machine, lapping compound, and valve seat refacing set, reface the valve seats to manufacturer's specification. All items on checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Removed cylinder head and valve spring.	____	____
2. Checked valve, stem, and guide for wear.	____	____
3. Ground valves to specified face angle.	____	____
4. Selected proper pilot for valve guide and dressed refacing stone.	____	____
5. Lapped valve to its seat and repeated for all valves.	____	____
6. Reinstalled valves, springs and keepers in their original place.	____	____
7. Reinstalled head and adjusted valves.	____	____

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 114

TASK: Remove carbon from ring grooves.

STANDARD OF PERFORMANCE OF TASK:
In the shop area, remove the carbon from the piston ring grooves. The piston will be clean, but no metal will be shaved from the piston.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist

CONDITIONS FOR PERFORMANCE OF TASK:
Given a mechanic's tool set, a ring groove cleaner, or an old ring and ring expander, remove the carbon from the ring grooves.

ENABLING OBJECTIVE(S):

1. Know shop safety.
2. Use of hand tools.

RESOURCES:

1. Jacobs/Harrell. **Agricultural Power and Machinery,** pp. 255-256.

TEACHING ACTIVITIES:

1. List causes for carbon build up on piston.
2. Explain the effects of carbon on the face and inside the piston groove.
3. Identify proper cutter to clean piston groove without removing metal or damaging the piston.
4. Demonstrate the use of an old ring to cleaning the piston ring groove.
5. Demonstrate the proper procedure for removing the piston from the block and removing rings from the piston.

CRITERION REFERENCED MEASURE:

Practical Application:
The student will remove carbon and clean the piston to the teacher's satisfaction.

Method of Evaluating Practical Application:
Student must clean the piston to the teacher's satisfaction.

PERFORMANCE GUIDE:

1. Remove piston from engine.
2. Remove rings from piston.
3. Select proper cutter on ring groove cleaning tool and place tool on piston. Turn tool around piston to clean groove.
4. If groove cleaning tool with correct cutter is not available, a piece of an old ring makes a fair substitute.
5. **Be careful not to remove any metal from the piston.** Removal of any metal will affect ring side clearance.

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 115

TASK: Remove cylinder ridge.

STANDARD OF PERFORMANCE OF TASK:
In the shop area, remove a cylinder ridge from the piston cylinder. The ridge will be cut deep enough to allow piston to be removed, but not deeper than the ring wear mark.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist

CONDITIONS FOR PERFORMANCE OF TASK:
Given a mechanic's tool set and a ridge reamer, remove a cylinder ridge from the piston cylinder.

ENABLING OBJECTIVE(S):

1. Measuring with precision tools
2. Used hand tools.

RESOURCES:

1. Jacobs/Harrell. **Agricultural Power and Machinery,** pp. 265-268.

TEACHING ACTIVITIES:

1. Explain what causes cylinder ridges.
2. Demonstrate the use of an inside micrometer to determine the size of the ridge by measuring the ridge and measuring beneath the ridge. The difference will determine the amount needed to be removed.
3. Explain what damage can be caused by not removing the ridge.
4. List tools needed to remove the cylinder ridge.
5. Demonstrate how to properly remove the cylinder ridge.

CRITERION REFERENCED MEASURE:

Practical Application:
The student will remove the cylinder ridge without removing to much.

Method of Evaluating Practical Application:
Use the checklist for Performance Objective 115. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 115 EVALUATION

PERFORMANCE TEST FOR REMOVING CYLINDER RIDGE

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a mechanic's tool set and a ridge remover, remove a cylinder ridge from the piston cylinder. All steps on checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Cranked engine until piston is at bottom of the stroke.	______	______
2. Installed ridge reamer in top of cylinder.	______	______
3. Turned ridge reamer with a ratchet.	______	______
4. Reamed slowly and inspected ridge often.	______	______
5. Cleaned out cylinder carefully before moving piston.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 116

TASK: Remove piston assembly.

STANDARD OF PERFORMANCE OF TASK:
Remove the piston assembly from the designated tractor. The piston will be removed without damage to the piston or any other parts of the engine.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist

CONDITIONS FOR PERFORMANCE OF TASK:
Given a mechanic's tool set and a soft-faced hammer, remove a piston assembly from the designated tractor.

ENABLING OBJECTIVE(S):

1. Use hand tools.

RESOURCES:

1. Jacobs/Harrell. **Agricultural Power and Machinery,** pp. 251-256.

TEACHING ACTIVITIES:

1. Discuss and list the engine parts that need to be removed in order to remove piston assembly.
2. Name the parts of the piston assembly.
3. Explain the necessity to realign rod cap with the rod.
4. Demonstrate how to remove the head and oil pan and how to drive the piston out through the top of the block after the ridge has been removed.
5. Have students list all the safety steps used in removing the engine block from the tractor.

CRITERION REFERENCED MEASURE:

Practical Application:
The student will remove piston assembly from the designated tractor, without damaging any part of the piston assembly or block.

Method of Evaluating Practical Application:
Observe the student during piston removal and check for damage if the piston removal is successful. Check completed work.

PERFORMANCE GUIDE:

1. With head and oil pan removed and cylinder reamed, loosen rod cap bolts or nuts.
2. Check piston and rod for identifying marks. If they are not already marked, mark each piston, rod, and rod cap with cylinder number and direction of placement.
3. Tap rod cap loose with a soft-faced hammer if necessary.
4. Remove rod cap bolts (or nuts) and push piston out of cylinder.

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 117

TASK: Replace camshaft bearings.

STANDARD OF PERFORMANCE OF TASK:
Replace the camshaft bearings on the designated tractor. Disassembly and reassembly will be in the order recommended in the service manual and the new bearings will be the same size as those replaced. All parts will be to manufacturer's specifications and there will be no damage to any parts.

SOURCE OF STANDARD:
Fundamentals of Service — Engines, Deere and Company, Moline, Ill., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Using the designated tractor, a new set of camshaft bearings, the service manual for the tractor, a micrometer for measuring parts to specifications and the necessary tools and lubricants, replace the camshaft bearings.

ENABLING OBJECTIVE(S):

1. Read a micrometer.
2. Use of hand tools.
3. Ability to read.

RESOURCES:

1. Jacobs/Harrell. **Agricultural Power and Machinery,** pp. 257-261.

TEACHING ACTIVITIES:

1. Demonstrate how to disassemble the engine until the cam bearings are exposed.
2. Discuss the function of the cam bearings.
3. Demonstrate how to measure the outside diameter of the camshaft ends and how to determine the proper sizes cam bearings.
4. Discuss how the service manual is used to assist in engine disassembly and in determining rejection or acceptance of the camshaft.
5. Show students how to identify worn cam bearings.

CRITERION REFERENCED MEASURE:

Practical Application:
The student will replace camshaft bearings to manufacturer's specifications.

Method of Evaluating Practical Application:
Use the checklist for Performance Objective 117. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 117 EVALUATION

PERFORMANCE TEST FOR REPLACING CAMSHAFT BEARINGS

Student's Name **Date**

DIRECTIONS TO STUDENT: Using the designated tractor, a new set of camshaft bearings, the service manual for the tractor, a micrometer for measuring parts to specifications and the necessary tools and lubricants, replace the camshaft bearings. All steps must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All steps must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Followed service manual in removing all parts.	______	______
2.	Determined proper size bearings.	______	______
3.	Lined up the oil holes.	______	______
4.	Reassembled and measured the following parts: camfollowers, camlobes, and camshafts.	______	______
5.	Reassembled all other parts.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 118

TASK: Replace dry sleeves.

STANDARD OF PERFORMANCE OF TASK:
Replace the dry sleeves on the designated tractor. The old sleeves must be removed without damage to the block; the block must be thoroughly cleaned and the new sleeves must be fully seated.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a mechanic's tool set and a sleeve puller, replace dry sleeves.

ENABLING OBJECTIVE(S):

1. Ability to disassemble the engine.
2. Ability to use arbor press.
3. Use of hand tools.

RESOURCES:

1. Jacobs/Harrell. **Agricultural Power and Machinery,** pp. 265-266.

TEACHING ACTIVITIES:

1. Discuss and list the advantages and disadvantages of dry sleeves over wet sleeves.
2. Explain what happens to a new sleeve when it is put in the freezer.
3. Demonstrate how to remove the dry sleeve without damaging the cylinder block.
4. Demonstrate how to hone the sleeve after installation.
5. Explain why dry sleeves are used instead of using the cylinder wall.

CRITERION REFERENCED MEASURE:

Practical Application:
The student will replace dry sleeves.

Method of Evaluating Practical Application:
Use the checklist for Performance Objective 118. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 118 EVALUATION

PERFORMANCE TEST FOR REPLACING DRY SLEEVES

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a mechanic's tool set and sleeve puller, replace dry sleeves. All items on checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Cleaned and "miced" new sleeve.	________	________
2. Used sleeve puller to remove old sleeve without damage to block.	________	________
3. Turned sleeve puller only with hand tool.	________	________
4. Removed other sleeves the same way. Cleaned out cylinder holes in block.	________	________
5. Put new sleeve in freezer. After shrinkage, put in cylinder block.	________	________
6. Seated new sleeve (may tap with soft-faced hammer).	________	________

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 119

TASK: Replace oil pan gasket assembly.

STANDARD OF PERFORMANCE OF TASK:
Replace the oil pan gasket assembly on the designated tractor. The oil pan will be clean, the gasket will be in place and sealed, and the bolts will be tightened to the correct torque.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a mechanic's tool set and a torque wrench, gasket and gasket compound, replace the oil pan and gasket assembly.

ENABLING OBJECTIVE(S):

1. Ability to use torque wrench.
2. Ability to use hand tools.

RESOURCES:

1. Jacobs/Harrell. **Agricultural Power and Machinery,** p. 285.

TEACHING ACTIVITIES:

1. Discuss how to determine if the gasket needs a sealant added before installing the oil pan.
2. Show the student how to use the manual to find the torque specifications for the oil pan bolts.
3. Discuss the function of the oil pan gaskets.
4. Identify the different materials gaskets can be made from and tell where the different materials are used.
5. Demonstrate the proper procedure for replacing the oil pan gasket.

CRITERION REFERENCED MEASURE:

Practical Application:
The student will replace the oil pan gasket.

Method of Evaluating Practical Application:
Use the checklist for Performance Objective 119. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 119 EVALUATION

PERFORMANCE TEST FOR REPLACING OIL PAN GASKET ASSEMBLY

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a mechanic's tool set and a torque wrench, gasket and gasket compound, replace the oil pan and gasket assembly.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Drained engine oil.	______	______
2.	Removed oil pan.	______	______
3.	Cleaned oil pan. Removed all traces of gasket from oil pan and engine block.	______	______
4.	Placed gasket compound on oil pan side of gasket and placed gasket on oil pan.	______	______
5.	Ran bolts hand tight.	______	______
6.	Torqued bolts in 5 ft. lb. increments until specified torque is reached.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 120

TASK: Replace piston rings.

STANDARD OF PERFORMANCE OF TASK:
Replace the piston rings on the designated tractor. The piston must be clean and unscratched. All steps on the instructor checklist must be completed during the replacement process.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given new piston rings, a mechanic's tool set, a ring expander, a ridge reamer, a ring compressor, and a groove cleaner, replace old piston rings.

ENABLING OBJECTIVE(S):

1. Use of hand tools.
2. Ability to read.

RESOURCES:

1. Jacobs/Harrell. **Agricultural Power and Machinery,** p. 284.

TEACHING ACTIVITIES:

1. Identify and name the functions of the following tools: ring expander, ridge reamer, ring compressor, and groove cleaner.
2. Discuss the reasons for ring replacement.
3. Discuss and list steps needed to prepare the cylinder before installing new rings.
4. Identify the different types of rings and explain their functions.
5. Demonstrate how to correctly install piston rings without damages to piston or rings.

CRITERION REFERENCED MEASURE:

Practical Application:
The student will replace piston rings.

Method of Evaluating Practical Application:
Use the checklist for Performance Objective 120. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 120 EVALUATION

PERFORMANCE TEST FOR REPLACING PISTON RINGS

Student's Name **Date**

DIRECTIONS TO STUDENT: Replace the piston rings. Piston must be clean and unscratched. All steps on the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Removed head.	______	______
2. Removed oil pan.	______	______
3. Reamed ridge.	______	______
4. Removed piston.	______	______
5. Removed rings.	______	______
6. Cleaned piston.	______	______
7. Installed rings.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 121

TASK: Replace rear engine oil seal.

STANDARD OF PERFORMANCE OF TASK:
Install a rear engine oil seal on the designated tractor. The new seal will be correctly placed and will hold oil. All parts will be correctly placed and tightened.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a mechanic's tool set, a torque wrench, a new gasket, and a seal, install rear engine oil seal.

ENABLING OBJECTIVE(S):

1. Ability to disassemble and remove oil pan.
2. Use of hand tools.
3. Use of torque wrench.
4. Ability to read.

RESOURCES:

1. Jacobs/Harrell. **Agricultural Power and Machinery**, p. 285.

TEACHING ACTIVITIES:

1. Discuss the functions of the rear engine oil seal.
2. List the safety steps used when removing large engine parts.
3. Explain why the new seals must be lubricated before installation.
4. Identify the two materials that oil seals are usually made from.
5. Demonstrate how to replace rear engine oil seals.

CRITERION REFERENCED MEASURE:

Practical Application:
The student will replace rear engine oil seal.

Method of Evaluating Practical Application:
Use the checklist for Performance Objective 121. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 121 EVALUATION

PERFORMANCE TEST FOR REPLACING REAR ENGINE OIL SEAL

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a mechanic's tool set, a torque wrench, a new gasket, and a seal, install rear engine oil seal.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Removed and cleaned oil pan. Removed all traces of oil pan gasket.	______	______
2. Removed rear main bearing cap.	______	______
3. Loosened other main bearing caps.	______	______
4. Pulled out old seal.	______	______
5. Lubricated and installed top half of new seal.	______	______
6. Coated outside of new seal with sealing compound and installed.	______	______
7. Replaced and tightened main bearing cap and torqued.	______	______
8. Reinstalled oil pan with new gasket and sealing compound.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 122

TASK: Replace rocker arms.

STANDARD OF PERFORMANCE OF TASK:
Replace the rocker arms on the designated tractor. Valves will be adjusted to specifications and all steps will be completed on an instructor checklist.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given new rocker arms, a mechanic's tool set, service manual, outside micrometers and telescoping gauges, replace the rocker arms on the designated tractor.

ENABLING OBJECTIVE(S):

1. Ability to remove and disassemble cylinder head.
2. Use of outside micrometer and telescoping gauges.
3. Use of hand tools.
4. Ability to read.

RESOURCES:

1. Jacobs/Harrell. **Agricultural Power and Machinery,** p. 265.

TEACHING ACTIVITIES:

1. Explain the functions of the rocker arm.
2. Explain the causes for rocker arm wear.
3. Demonstrate how to identify excessive wear from normal wear.
4. Discuss and identify all parts of the valve train.
5. Demonstrate how to replace the rocker arms.

CRITERION REFERENCED MEASURE:

Practical Application:
The student will replace rocker arms.

Method of Evaluating Practical Application:
Use the checklist for Performance Objective 122. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 122 EVALUATION

PERFORMANCE TEST FOR REPLACING ROCKER ARMS

Student's Name **Date**

DIRECTIONS TO STUDENT: Replace the rocker arms. Valves must be adjusted to specifications and all steps on checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Removed valve cover.		
2. Removed rocker arm assembly.		
3. Inspected parts.		
4. Installed new parts.		
5. Adjusted valves.		
6. Reinstalled valve cover.		

APPROVED: Yes _____ No _____

Evaluator's Signature Date

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 123

TASK: Replace valve guides.

STANDARD OF PERFORMANCE OF TASK:
Replace the valve guides on the designated engine. All guides needing service will be detected. Old guides will be removed without damage to the head, and new guides will be installed to specified position.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given new valve guides, a dial indicator, arbor press, and/or valve guide puller-driver, replace valve guides on the designated tractor.

ENABLING OBJECTIVE(S):

1. Ability to remove and disassemble cylinderhead.
2. Use of dial indicator.
3. Use of arbor press or valve guide puller.
4. Use of hand tools.

RESOURCES:

1. Jacobs/Harrell. **Agricultural Power and Machinery,** pp. 245-246.

TEACHING ACTIVITIES:

1. Discuss the symptoms that would cause you to check for valve guide trouble.
2. Explain the effect on engines of worn valve guides.
3. List and discuss the methods used for correcting worn valve guides.
4. Demonstrate how to use the measuring devices that are used to measure for valve guide wear and in measuring valves.
5. Demonstrate the use of manufacturer's specification to determine the proper procedure to repair worn valve guides.

CRITERION REFERENCED MEASURE:

Practical Application:
The student will replace valve guides.

Method of Evaluating Practical Application:
Use the checklist for Performance Objective 123. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 123 EVALUATION

PERFORMANCE TEST FOR REPLACING VALVE GUIDES

Student's Name **Date**

DIRECTIONS TO STUDENT: Given new valve guides, a dial indicator, arbor press, and/or valve guide puller driver, replace valve guides on the designated tractor.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1.	Measured valve stem clearance and rejected all guides that are worn.	______	______
2.	Pressed out bad guides.	______	______
3.	Pressed new guides in place.	______	______
4.	Made sure guides inserted to proper depth as specified in service manual.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 124

TASK: Replace wet sleeves.

STANDARD OF PERFORMANCE OF TASK:
Replace the wet sleeves on a designated engine. Disassembly and reassembly will follow manufacturer's instructions. The out of roundness will be within manufacturer's specifications, the cylinder will not leak, and there will be no damage to any parts.

SOURCE OF STANDARD:
Fundamentals of Service -- Engines, Deere and Company, Moline, Ill., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Given new sleeves, service manual, lubricants, seals, and the necessary tools and checking equipment, replace the wet sleeves on a designated engine.

ENABLING OBJECTIVE(S):

1. Ability to disassemble the engine.
2. Use of hand tools.
3. Ability to read.

RESOURCES:

1. Jacobs/Harrell. **Agricultural Power and Machinery,** p. 265.

TEACHING ACTIVITIES:

1. Explain the effects of freezing on a new sleeve.
2. Show how to identify scale deposits in the water jacket and explain what causes them.
3. Demonstrate how to remove the wet sleeve without damaging the cylinder block.
4. List and discuss the advantages and disadvantages of the wet sleeves over dry sleeves.
5. Demonstrate how to correctly install the wet sleeves without damage to any parts.

CRITERION REFERENCED MEASURE:

Practical Application:
The student will replace a wet sleeve.

Method of Evaluating Practical Application:
Use the checklist for Performance Objective 124. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 124 EVALUATION

PERFORMANCE TEST FOR REPLACING WET SLEEVES

Student's Name **Date**

DIRECTIONS TO STUDENT: Given new sleeves, service manual, lubricants, seals, and the necessary tools and checking equipment, replace the wet sleeves on a designated engine.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Read manufacturer's service manual for instruction.		
2.	Used screw threaded on impact puller to remove sleeves.		
3.	Cleaned the lower sealing ring surface in the block.		
4.	Measured the cylinder bore for taper and out of roundness. Rebored and honed if necessary. Cleaned thoroughly.		
5.	Cleaned all deposits from under the flange of sleeve and mating bore in block.		
6.	Checked sleeve bore in block.		
7.	Cleaned the lower sealing surfaces in the block and sleeve to prevent coolant leaks when sleeve is installed.		
8.	Installed new sleeve without seals to check height.		
9.	Removed sleeve and put new seals on sleeve. Lubricated the seal and the mating surfaces in the block.		
10.	Worked sleeve into place (by hand). Finished seating the sleeve by placing a wood block over it and hammering gently.		

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 124 (Continued)

11. Checked for correct liner installation by measuring the out of roundness. ______ ______

APPROVED: Yes ____ No ____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 125

TASK: Service intake manifold.

STANDARD OF PERFORMANCE OF TASK:
Service the intake manifold on the designated tractor. The manifold will be clean, correctly installed, and torqued.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Using the designated tractor and service manual, and a mechanic's tool set, service the intake manifold.

ENABLING OBJECTIVE(S):

1. Use of hand tools.

RESOURCES:

1. Jacobs/Harrell. **Agricultural Power and Machinery,** p. 287.

TEACHING ACTIVITIES:

1. Explain the function of the intake manifold.
2. Discuss and list the causes of intake manifold warpage.
3. Discuss the importance of a tight seal on the intake manifold?
4. List the steps used in removing the intake manifold.
5. Demonstrate the correct steps in servicing the intake manifold.

CRITERION REFERENCED MEASURE:

Practical Application:
The student will service the intake manifold.

Method of Evaluating Practical Application:
Use the checklist for Performance Objective 125. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 125 EVALUATION

PERFORMANCE TEST FOR SERVICING INTAKE MANIFOLD

Student's Name **Date**

DIRECTIONS TO STUDENT: Using the designated tractor and service manual, and a mechanic's tool set, service the intake manifold.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Removed carburetor.		
2.	Removed intake manifold.		
3.	Cleaned manifold and checked manifold.		
4.	Cleaned old gasket material from mating surfaces.		
5.	Reinstalled manifold with new gaskets, tightened to specified torque.		
6.	Reinstalled carburetor with new gasket.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 126

TASK: Test valve springs.

STANDARD OF PERFORMANCE OF TASK:
Test the valve springs on the designated tractor. All defective springs will be replaced and the engine will be reassembled. All springs will indicate strength as specified by the manufacturer.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a mechanic's tool set, a service manual, a valve spring compressor, and a valve spring tester, test the valve springs on the designated tractor.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Use of hand tools.

RESOURCES:

1. Jacobs/Harrell. **Agricultural Power and Machinery,** p. 251.

TEACHING ACTIVITIES:

1. Discuss the function of the valve springs.
2. List the safety steps in checking valve spring tension.
3. Explain why exhaust valve springs usually lose tension faster than the intake springs.
4. Demonstrate the use of the valve spring compressor and valve spring remover.
5. Demonstrate the safe and correct way to test valve springs.

CRITERION REFERENCED MEASURE:

Practical Application:
The student will test the valve springs.

Method of Evaluating Practical Application:
Use the checklist for Performance Objective 126. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 126 EVALUATION

PERFORMANCE TEST FOR TESTING VALVE SPRINGS

Student's Name **Date**

DIRECTIONS TO STUDENT: Given a mechanic's tool set, a service manual, a valve spring compressor, and a valve spring tester, test the valve springs on the designated tractor.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Removed valve cover, head and rocker assembly.		
2.	Removed valves and valve spring keepers.		
3.	Using valve spring tester and torque wrench, tested each spring.		
4.	Replaced faulty springs.		
5.	Reassembled engine and adjusted valve.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING BASIC ENGINE

PERFORMANCE OBJECTIVE V-TECS 127

TASK: Torque main bearings.

STANDARD OF PERFORMANCE OF TASK:
On the designated tractor, torque the main bearings. All main bearings will be within torque specifications.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Using the designated tractor and service manual and a mechanic's tool set, torque the main bearings on the tractor.

ENABLING OBJECTIVE(S):

1. Use of hand tools.
2. Ability to read.

RESOURCES:

1. Jacobs/Harrell. **Agricultural Power and Machinery,** pp. 281-282.

TEACHING ACTIVITIES:

1. Explain the function of the main bearings.
2. Discuss why main bearings must be torqued.
3. List and discuss the causes of problems associated with main bearings.
4. Demonstrate how to correctly torque the main bearing.
5. Have the students read pages 281 and 282 on Main Bearings in textbook, **Agricultural Power and Machinery.**

CRITERION REFERENCED MEASURE:

Practical Application:
The student will torque the main bearings.

Method of Evaluating Practical Application:
The student must torque main bearing to manufacturer's specification.

PERFORMANCE GUIDE:

1. Determine torque specifications from service manual.
2. With crankshaft installed and all main bearings and bearing caps in place, tighten both bolts of each bearing in sequence by five foot pound increments until all bearings are to specified torque.

MAINTAINING AND SERVICING LUBRICATION SYSTEM

DUTY: MAINTAINING AND SERVICING LUBRICATION SYSTEM

PERFORMANCE OBJECTIVE V-TECS 128

TASK: Change oil filter.

STANDARD OF PERFORMANCE OF TASK:
Change the oil filter on the designated tractor. When finished, the filter will be the one specified and the oil will be at the "full" line.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given the manufacturer service manual, a replacement filter, fresh oil and the necessary tools, change the oil filter.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Use safety rules concerning hand tools.
3. Use of hand tools.

RESOURCES:

1. **Fundamentals of Service — Engines,** pp. 7-1 to 7-19.
2. Tractor Service Manual for specific tractor.

TEACHING ACTIVITIES:

1. Explain to the students the importance of keeping the engine oil clean.
2. Have students read **FOS — Engines,** Chapter 7, pp. 7-1 to 7-19.
3. Show students engine parts with oil caked on them for lack of oil change.
4. Show students how to change oil and oil filter.
5. Have students list steps followed in oil and oil filter changes.

CRITERION REFERENCED MEASURE:

Practical Application:
Have students change oil filter using the steps in the checklist.

Method of Evaluating Practical Application:
Use checklist for Performance Objective 128, all steps must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 128 EVALUATION

PERFORMANCE TEST FOR CHANGING OIL FILTER

Student's Name **Date**

DIRECTIONS TO STUDENT: Change oil filter on assigned tractor. All steps in the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Cleaned drain plug and removed.	______	______
2. Removed and replaced oil filter.	______	______
3. If filter is a spin on, lubricated O-ring.	______	______
4. If filter is cartridge, make sure gasket is straight.	______	______
5. Replaced plug and filled with oil.	______	______
6. Cranked engine and checked for leaks.	______	______
7. Rechecked oil level.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING LUBRICATION SYSTEM

PERFORMANCE OBJECTIVE V-TECS 129

TASK: Change tractor oils (engine and/or transmission)

STANDARD OF PERFORMANCE OF TASK:
Change the oil in the designated tractor. When completed, the dip stick will show the oil is at (but not exceeding the "full" mark and there will be no leaks.

SOURCE FOR STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a wrench for the drain plug, new oil of the type and grade recommended in the operator's manual, clean rags, and a container for the old oil, change the tractor oil.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Understand safety rules concerning hand tools.
3. Use of hand tools.

RESOURCES:

1. **Fundamental of Service - Engines,** pp. 7-1 to 7-19.
2. Service Manual for specific tractor.

TEACHING ACTIVITIES:

1. Explain to the students the importance of clean good quality oil in an engine.
2. Have students read **FOS — Engines,** Chapter 7, pp. 7-10 to 7-19
3. Tell the students how oils break down.
4. Demonstrate how to change oil.
5. Discuss with students the proper methods of disposal of used motor oils.

CRITERION REFERENCED MEASURE:

Practical Application:
Have students change oil in a tractor using the steps in the checklist.

Method of Evaluating Practical Application:
Use checklist for Performance Objective 129, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 129 EVALUATION

PERFORMANCE TEST FOR CHANGING TRACTOR OIL (ENGINE AND TRANSMISSION)

Student's Name ______________________ **Date** __________

DIRECTIONS TO STUDENT: Change oil (engine and transmission) on assigned tractor. All steps in the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Cleaned around drain plug and removed.	________	________
2. Flushed out crankcase on transmission.	________	________
3. Replaced plug and refilled with oil.	________	________
4. Cranked up and checked for leaks.	________	________
5. Rechecked oil level.	________	________

APPROVED: Yes _____ No _____

Evaluator's Signature ______________________ **Date** __________

DUTY: MAINTAINING AND SERVICING LUBRICATION SYSTEM

PERFORMANCE OBJECTIVE V-TECS 130

TASK: Check engine crankcase oil level.

STANDARD OF PERFORMANCE OF TASK:
Check the engine crankcase oil level on the designated tractor. Upon completion the dip stick reading must agree with that of the instructor.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a clean cloth and oil, check the engine crankcase oil level.

ENABLING OBJECTIVE(S):

1. Ability to be able to read.

RESOURCES:

1. **Fundamentals of Service — Engines,** pp. 7-1 to 7-19.
2. Service Manual for specific tractor.

TEACHING ACTIVITIES:

1. Explain to the students the importance of keeping engine oil at the proper level.
2. Have students read **FOS — Engines,** Chapter 7, pp. 7-1 to 7-19.
3. Show students damaged engine parts caused from oil level being too low.
4. Show students how to check engine oil.
5. Have them check the oil level in a tractor.

CRITERION REFERENCED MEASURE:

Practical Application:
Have student change engine oil using the steps in the checklist.

Method of Evaluating Practical Application:
Use checklist for Performance Objective 130, all the steps must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 130 EVALUATION

PERFORMANCE TEST FOR CHECKING ENGINE CRANKCASE OIL LEVEL

Student's Name **Date**

DIRECTIONS TO STUDENT: Check engine crankcase oil level on assigned tractor. All steps in the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1. Turned off engine and made sure tractor is level.	______	______
2. Pulled dip stick and cleaned with a clean cloth.	______	______
3. Reinserted dipstick and seated fully.	______	______
4. Pulled out and read dip stick.	______	______
5. Reinstalled dip stick.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING LUBRICATION SYSTEM

PERFORMANCE OBJECTIVE V-TECS 131

TASK: Check transmission and/or differential lubricant levels.

STANDARD OF PERFORMANCE OF TASK:
Check the transmission and/or differential lubricant on a designated engine equipped with a dip stick. The dip stick should be clean when inserted and the student's reading should be the same as the instructor's.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a shop rag, check the transmission and/or differential lubricant level on an engine equipped with a dip stick.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Knowledge of safety rules concerning hand tools.

RESOURCES:

1. **Fundamentals of Service — Engines,** pp. 7-1 to 7-19.
2. Service Manual for specific tractor.

TEACHING ACTIVITIES:

1. Discuss with students the damage that can occur when lubricant levels are too low.
2. Have students read **FOS — Engines,** Chapter 7, pp. 7-1 to 7-19.
3. Pass around and discuss examples of gears damaged from lack of lubrication.
4. Demonstrate to students how to check lubricant levels.
5. Have students check lubricant levels on assigned tractor.

CRITERION REFERENCED MEASURE:

Practical Application:
Have students check lubricant levels with dipstick using the steps in the checklist.

Method of Evaluating Practical Application:
Use checklist for Performance Objective 131, all steps must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 131 EVALUATION

PERFORMANCE TEST FOR CHECKING TRANSMISSION AND/OR DIFFERENTIAL LUBRICANT LEVELS

Student's Name **Date**

DIRECTIONS TO STUDENT: Check transmission and/or differential lubricant levels with dip stick on assigned tractor. All steps in the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Cleaned around dip stick.	______	______
2. Pulled out dip stick.	______	______
3. Wiped dip stick with a clean cloth.	______	______
4. Reinserted dip stick.	______	______
5. Pulled out dip stick and took reading.	______	______
6. Reinsralled dipstick.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING LUBRICATION SYSTEM

PERFORMANCE OBJECTIVE V-TECS 132

TASK: Check transmission and/or differential lubricant levels (continued).

STANDARD OF PERFORMANCE OF TASK:
Check the transmission and/or differential lubricant level on a designated engine equipped with a plug. The engine will have the proper oil level as specified in operator's manual and the plug will be tight when the operation is complete.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a wrench to fit the type of plug head and proper lubricant, check the transmission and/or differential lubricant level on a plug equipped engine.

ENABLING OBJECTIVE(S):
1. Ability to read.
2. Knowledge of safety rules concerning hand tools.
3. Use of hand tools.

RESOURCES:
1. **Fundamentals of Service -- Engines,** pp. 7-1 to 7-9.
2. Service Manual for specific tractor.

TEACHING ACTIVITIES:
1. Discuss with student the damage that can occur when lubricant levels are too low.
2. Have student read **FOS -- Engines,** Chapter 7, pp. 7-1 to 7-9.
3. Discuss and show examples of gears damaged by lack of lubrication.
4. Demonstrate to students how to check lubricant levels on transmissions with a plug.
5. Have student check lubricant levels on transmissions with a plug.

CRITERION REFERENCED MEASURE:

Practical Application:
Have student check lubricant level on transmission with a plug using the steps in the checklist.

Method of Evaluating Practical Application:
Use checklist for Performance Objective 132, all steps must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 132 EVALUATION

PERFORMANCE TEST FOR CHECKING TRANSMISSIONS AND/OR DIFFERENTIAL LUBRICANT LEVEL

Student's Name **Date**

DIRECTIONS TO STUDENT: Check transmission and/or differential lubricant level on assigned tractor. All steps in the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Cleaned around level plug.	______	______
2. Removed level plug (if oil comes out you don't need to add any).	______	______
3. Added lubricant until it runs out of check plug hole if needed.	______	______
4. Reinstalled plug.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature Date

DUTY: MAINTAINING AND SERVICING LUBRICATION SYSTEM

PERFORMANCE OBJECTIVE V-TECS 133

TASK: Drain and refill differentials.

STANDARD OF PERFORMANCE OF TASK:
Drain and refill the differentials on the designated tractor. Both the lubricant and the lubrication level will be correct according to manufacturer's specifications. Both fill and drain plugs will be tight.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a container for used oil, plug wrenches, service manual, lubricant, and shop rags, drain and refill the differentials.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Knowledge of safety rules concerning hand tools.
3. Use of hand tools.

RESOURCES:

1. **Fundamentals of Service -- Engines,** pp. 7-1 to 7-19.
2. Service Manual for specific tractor.

TEACHING ACTIVITIES:

1. Discuss with student the cost of changing oil in the differential as compared to cost of having the rear end repaired.
2. Have students read **FOS -- Engines,** Chapter 7, pp. 7-1 to 7-19.
3. Explain to student different viscosities of lubricating oils.
4. Show students how to drain and refill differential.
5. Have student drain and refill differential on assigned tractor.

CRITERION REFERENCED MEASURE:

Practical Application:
Have students drain and refill differential using the steps in the checklist.

Method of Evaluating Practical Application:
Use checklist for Performance Objective 133, all steps must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 133 EVALUATION

PERFORMANCE TEST FOR DRAINING AND REFILLING DIFFERENTIALS

Student's Name **Date**

DIRECTIONS TO STUDENT: Drain and refill differential on assigned tractor. All steps in the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Cleaned around and removed fill plug.		
2. Removed drain plug.		
3. Flushed out differential.		
4. Replaced drain plug.		
5. Filled to correct level.		
6. Reinserted fill plug.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING LUBRICATION SYSTEM

PERFORMANCE OBJECTIVE V-TECS 134

TASK: Pack wheel bearings.

STANDARD OF PERFORMANCE OF TASK:
Pack the wheel bearings on the designated tractor. When completed, there will be no drag or end play. All steps on the instructor's checklist will be completely acceptable.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a mechanic's tool set, replacement parts, number 2 lithium grease, and shop rags, pack the wheel bearings on the designated tractor.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Knowledge of safety rules concerning shop tools and equipment.
3. Use of hand tools.

RESOURCES:

1. **Fundamentals of Service -- Bearing and Seals,** pp. 30-40.

TEACHING ACTIVITIES:

1. Discuss how wheel bearings support heavy loads and the importance of keeping them greased and tightened properly.
2. Read **FOS - Bearings and Seals,** pp. 30-40.
3. Show examples of worn wheel bearings to class.
4. Demonstrate to students how to pack wheel bearings.
5. Have students pack wheel bearings.

CRITERION REFERENCED MEASURE:

Practical Application:
Have students pack wheel bearings using steps in the checklist.

Method of Evaluating Practical Application:
Use checklist for Performance Objective 134, all steps must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 134 EVALUATION

PERFORMANCE TEST FOR PACKING WHEEL BEARING

Student's Name **Date**

DIRECTIONS TO STUDENT: Pack wheel bearings on assigned tractor. All steps in the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Locked brakes and raised tractor.		
2.	Put jack stands under front end.		
3.	Removed hub cap, cotter pin, nut and washer.		
4.	Pulled off wheel hub.		
5.	Removed bearings and seals.		
6.	Cleaned all parts.		
7.	Packed bearings with appropriate grease.		
8.	Installed bearings and seals.		
9.	Installed washer, nut and tightened nut.		
10.	Tightened nut to get the right tension on wheel.		
11.	Installed new cotter pin in slotted nut.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING LUBRICATION SYSTEM

PERFORMANCE OBJECTIVE V-TECS 135

TASK: Service oil coolers.

STANDARD OF PERFORMANCE OF TASK:
Service the oil cooler on the designated tractor. When service is complete, there will be no visible dirt on the cooler and the cooler will be free of leaks.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a parts cleaning tank, flare nut wrenches, an air supply and flow gun, and a water tank, service the oil cooler.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Knowledge of safety rules concerning shop tools and equipment.
3. Use of hand tools.

RESOURCES:

1. **Fundamentals of Service — Engines,** pp. 7-1 to 7-19.

TEACHING ACTIVITIES:

1. Explain to the students the importance of keeping the oil cool in diesel engines.
2. Have them read **FOS -- Engines,** Chapter 7, pp. 7-1 to 7-19.
3. Pass around and discuss an example of a oil cooler for class to see.
4. Demonstrate how to service an oil cooler.
5. Have students service an oil cooler on a tractor.

CRITERION REFERENCED MEASURE:

Practical Application:
Have students service an oil cooler using the steps in the checklist.

Method of Evaluating Practical Application:
Use checklist for Performance Objective 135, all steps must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 135 EVALUATION

PERFORMANCE TEST FOR SERVICING OIL COOLERS

Student's Name **Date**

DIRECTIONS TO STUDENT: Service oil cooler on assigned tractor. All steps in the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe students. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Removed oil cooler.		
2. Cleaned dirt from fins.		
3. Blew out oil tubes with air hose.		
4. Checked for leaks.		
5. Repaired or replaced.		
6. Reinstalled oil cooler.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING LUBRICATION SYSTEM

PERFORMANCE OBJECTIVE V-TECS 136

TASK: Service oil pumps.

STANDARD OF PERFORMANCE OF TASK:
Service the oil pump on the designated tractor. All parts will be correctly reinstalled and there will be no oil leaks.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a complete mechanic's tool set, oil, gaskets, solvent and sealers, service the oil pump.

ENABLING OBJECTIVE(S):
1. Ability to read.
2. Knowledge of safety rules concerning hand tools and shop equipment.
3. Ability to read a feeler gauge.
4. Use of hand tools.

RESOURCES:
1. **Fundamentals of Service — Engines,** pp. 7-1 to 7-19.
2. Service Manual for specific tractor.

TEACHING ACTIVITIES:
1. Discuss with the students the damage that can occur if you don't have the proper oil pressure in an engine.
2. Have students read **FOS -- Engines,** Chapter 7, pp. 7-1 to 7-19.
3. Pass around examples of oil pumps.
4. Demonstrate to students how to service an oil pump.
5. Have students service an oil pump.

CRITERION REFERENCED MEASURE:

Practical Application:
Have students service an oil pump using steps in the checklist.

Method of Evaluating Practical Application:
Use checklist for Performance Objective 136, all steps must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V TECS 136 EVALUATION

PERFORMANCE TEST FOR SERVICING OIL PUMPS

Student's Name **Date**

DIRECTIONS TO STUDENT: Service oil pump on assigned tractor. All steps in the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Drained oil from engine.		
2.	Removed oil pan.		
3.	Removed oil pump.		
4.	Disassembled oil pump and cleaned.		
5.	Inspected parts for wear or damage.		
6.	Replaced needed parts.		
7.	Primed oil pump and installed.		
8.	Torqued bolts, if needed.		
9.	Replaced oil pan gasket.		
10.	Replaced oil pan.		
11.	Added oil to proper level.		
12.	Cranked engine and checked oil pressure.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

MAINTAINING AND SERVICING CLUTCHES

DUTY: MAINTAINING AND SERVICING CLUTCHES

PERFORMANCE OBJECTIVE V-TECS 137

TASK: Adjust clutch free play.

STANDARD OF PERFORMANCE OF TASK:
Adjust the clutch free play on the designated tractor. The adjustment will be made to manufacturer's specifications.

SOURCE OF STANDARD:
Fundamentals of Service — Power Trains, Deere and Company, Moline, Ill., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Using the clutch on the designated tractor, the service manual, a distance-measuring device and the right size open-ended wrench, adjust the clutch free play.

ENABLING OBJECTIVE(S):

1. Know shop safety.
2. Use of hand tools.
3. Ability to read.

RESOURCES:

1. Operator manual for tractor.
2. Service manual.

TEACHING ACTIVITIES:

1. Discuss shop safety.
2. Discuss the function of clutches.
3. Demonstrate how to check for proper clutch free play.
4. Demonstrate the procedure used to adjust a clutch.
5. Have the students list the steps followed in clutch adjustment.

CRITERION REFERENCED MEASURE:

Practical Application:
Adjust free play in clutch pedal.

Method of Evaluating Practical Application:
Use the checklist for Performance Objective 137. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V TECS 137 EVALUATION

PERFORMANCE TEST FOR ADJUSTING CLUTCH FREE PLAY

Student's Name **Date**

DIRECTIONS TO STUDENT: Adjust free play in clutch pedal.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Checked service manual for proper free play.	____	____
2. Measured free play and compared to specifications.	____	____
3. Adjusted free play.	____	____

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING CLUTCHES

PERFORMANCE OBJECTIVE V-TECS 138

TASK: Service a dry clutch.

STANDARD OF PERFORMANCE OF TASK:
Service the dry clutch on the designated tractor. When servicing is complete, the clutch will operate according to manufacturer's specifications, and there will not be excessive lubrication of the bearings or release fork.

SOURCE OF STANDARD:
Fundamentals of Service — Power Trains, Deere and Company, Moline, Ill., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Using the manufacturer's service manual and the necessary tools and replacement parts, service a dry clutch.

ENABLING OBJECTIVE(S):

1. Know shop safety.
2. Use of hand tools.
3. Ability to read.

RESOURCES:

1. Operator's manual for tractor.
2. Service manual.

TEACHING ACTIVITIES:

1. Discuss shop safety.
2. Discuss dry clutch operation.
3. Demonstrate the servicing of a dry clutch.
4. Discuss the use of the service manual when servicing a dry clutch.
5. Have the students list the steps followed in servicing a dry clutch.

CRITERION REFERENCED MEASURE:

Practical Application:
Service dry clutch.

Method of Evaluating Practical Application:
Use the checklist for Performance Objective 138. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 138 EVALUATION

PERFORMANCE TEST FOR SERVICING A DRY CLUTCH

Student's Name **Date**

DIRECTIONS TO STUDENT: Service a dry clutch. Clearance must be within tolerance stated in service manual.

DIRECTIONS TO EVALUATOR: Provide student needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Checked release and pressure mechanism.	______	______
2. Adjusted release levers.	______	______
3. Examined clutch.	______	______
4. Checked clutch for free play.	______	______
5. Lubricated pilot bearing, release bearing and release fork.	______	______
6. Made clutch adjustments following instructions in service manual.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING CLUTCHES

PERFORMANCE OBJECTIVE V-TECS 139

TASK: Service an expanding shoe clutch.

STANDARD OF PERFORMANCE OF TASK:
Service an expanding shoe clutch on the designated tractor. Disassembly to reassembly will be in the order specified by the manufacturer. All worn and damaged parts will be repaired or replaced, and the serviced clutch will function as specified.

SOURCE OF STANDARD:
Fundamentals of Service — Power Trains, Deere and Company, Moline, Ill., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Using the service manual, solvents, lubricants, replacement parts and the necessary tools, service an expanding shoe clutch.

ENABLING OBJECTIVE(S):

1. Know shop safety practices.
2. Use of hand tools.
3. Ability to read.

RESOURCES:

1. Operator's manual for tractor.
2. Service manual.

TEACHING ACTIVITIES:

1. Discuss shop safety.
2. Discuss expanding shoe clutches and their operation.
3. Demonstrate disassembly and reassembly of an expanding shoe clutch.
4. Discuss wear points and tolerances.
5. Have students disassemble and reassemble shoe clutch.

CRITERION REFERENCED MEASURE:

Practical Application:
Service the expanding shoe clutch.

Method of Evaluating Practical Application:
Using the checklist for Performance Objective 139. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V TECS 139 EVALUATION

PERFORMANCE TEST FOR SERVICING AN EXPANDING SHOE CLUTCH

Student's Name **Date**

DIRECTIONS TO STUDENT: Service an expanding shoe clutch on the designated tractor. Disassemble and reassemble according to manufacturer's specifications. Using the service manual, repair or replace worn or damaged parts as per specifications. All steps on checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Determined clutch type and specifications from reading manufacturer's service manual.		
2. Removed necessary parts to reach clutch.		
3. Checked, repaired or replaced outer member, inner member, release bearing, pivot links, vanes and vane spacing, and the shoes.		
4. Cleaned and lubricated all parts.		
5. Reassembled according to manufacturer's recommendations.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING CLUTCHES

PERFORMANCE OBJECTIVE V-TECS 140

TASK: Service a magnetic clutch.

STANDARD OF PERFORMANCE OF TASK:
Service a magnetic clutch in the shop area. Upon completion of the task, the pulley will spin without interference and the clutch will engage properly.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given end wrenches, jumper wire, and a pulley puller, service a magnetic clutch installing a new coil if necessary.

ENABLING OBJECTIVE(S):

1. Know shop safety practices.
2. Use of hand tools.
3. Ability to read.

RESOURCES:

1. Operator's manual.
2. Service manual.

TEACHING ACTIVITIES:

1. Discuss shop safety.
2. Discuss magnetic clutches, their function and operation.
3. Demonstrate "jumper wire" test for clutch engagement.
4. Discuss proper use of pulley puller.
5. Demonstrate proper use of pulley puller.
6. Demonstrate what to look for in worn parts, etc. in the clutch.
7. Have students perform tasks on designated tractor.

CRITERION REFERENCED MEASURE:

Practical Application:
Service the assigned magnetic clutch.

Method of Evaluating Practical Application:
Using the checklist for Performance Objective 140. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 140 EVALUATION

PERFORMANCE TEST FOR SERVICING A MAGNETIC CLUTCH

Student's Name **Date**

DIRECTIONS TO STUDENT: Service the magnetic clutch on the designated tractor. Replace or repair worn parts as per manufacturer's specifications. All steps on check list must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Performed "jumper wire" test properly.	______	______
2. Pulled pulley, clutch plate, and bearing properly.	______	______
3. Removed and installed new coil in correct position.	______	______
4. Reinstalled pulley and spun to check for interference.	______	______
5. Checked clutch for proper operation.	______	______
6. Performed "jumper wire" test, assuring proper clutch performance.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING CLUTCHES

PERFORMANCE OBJECTIVE V-TECS 141

TASK: Service an overrunning clutch.

STANDARD OF PERFORMANCE OF TASK:
Service the designated overrunning clutch in the shop area. Disassembly and reassembly will follow manufacturer's instructions and the clutch will operate to specifications. There will be no unnecessary damage to any parts.

SOURCE OF STANDARD:
Fundamentals of Service -- Power Trains, Deere and Company, Moline, Ill., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a defective overrunning clutch, the manufacturer's service manual, testing equipment, replacement parts and the necessary tools, service the clutch.

ENABLING OBJECTIVE(S):

1. Know shop safety practices.
2. Use of hand tools.
3. Ability to read.

RESOURCES:

1. Operator's manual for designated tractor.
2. Service manual.

TEACHING ACTIVITIES:

1. Discuss shop safety.
2. Discuss overrunning clutch, its function and operation.
3. Demonstrate defective clutch and wear tolerances.
4. Discuss and demonstrate the three basic types of overrunning clutches.
5. Discuss tolerances for wear, etc. as per service manual.
6. Have students test, repair, or replace overrunning clutch as per service manual.

CRITERION REFERENCED MEASURE:

Practical Application:
Service an overrunning clutch.

Method of Evaluating Practical Application:
Using the checklist for Performance Objective 141. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 141 EVALUATION

PERFORMANCE TEST FOR SERVICING AN OVERRUNNING CLUTCH

Student's Name **Date**

DIRECTIONS TO STUDENT: Service an overrunning clutch. Disassembly and reassembly will follow manufacturer's instructions and clutch will operate to specifications. All steps on check list must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Serviced and lubricated clutch.	______	______
2. Tested, repaired or replaced damaged parts.	______	______
3. Reassembled clutch and tested to see if it meets manufacturer's specifications.	______	______
4. Adjusted (if necessary).	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING CLUTCHES

PERFORMANCE OBJECTIVE V-TECS 142

TASK: Service a wet clutch.

STANDARD OF PERFORMANCE OF TASK:
Service the wet clutch on the designated tractor. Upon completion there will be no leaks and the oil level will be to specifications.

SOURCE OF STANDARD:
Fundamentals of Service — Power Trains, Deere and Company, Moline, Ill., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Given the manufacturer's service manual, new seals, the specified oil and the necessary tools, service a wet clutch.

ENABLING OBJECTIVE(S):

1. Know shop safety practices.
2. Use of hand tools.
3. Ability to read.

RESOURCES:

1. Operator's manual.
2. Service manual.

TEACHING ACTIVITIES:

1. Discuss shop safety.
2. Discuss wet clutches, their function and operation.
3. Demonstrate servicing wet clutch on designated tractor.
4. Have students service wet clutch.
5. Have the students list the steps performed when servicing wet clutches.

CRITERION REFERENCED MEASURE:

Practical Application:
Service wet clutch on designated tractor.

Method of Evaluating Practical Application:
Using the check list for Performance Objective 142. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 142 EVALUATION

PERFORMANCE TEST FOR SERVICING A WET CLUTCH

Student's Name **Date**

DIRECTIONS TO STUDENT: Service wet clutch on designated tractor. Upon completion there should be no oil leaks and oil level should be to specifications. All steps on checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1. Checked oil level and looked for leaks.		
2. Disassembled according to manufacturer's service manual.		
3. Checked oil circulation.		
4. Checked lines for possible blockage.		
5. Checked inlet lines and filter for dirt.		
6. Reassembled clutch.		
7. Checked oil level and added proper grade and type if needed.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

MAINTAINING AND SERVICING HYDRAULICS

DUTY: MAINTAINING AND SERVICING HYDRAULICS

PERFORMANCE OBJECTIVE V-TECS 143

TASK: Change hydraulic filters.

STANDARD OF PERFORMANCE OF TASK:
Change the hydraulic filters on the designated tractor. The new filters will be the type recommended by the service manual. They will be installed correctly and function as specified. The relief valve will be clean and operative and oil will be replaced if indicated.

SOURCE OF STANDARD:
Fundamentals of Service -- Hydraulics, Deere and Company, Moline, Ill., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Given the new filters recommended in the manufacturer's service manual, new parts and clean oil if needed, and the necessary tools, change the hydraulic oil filters.

ENABLING OBJECTIVE(S):

1. Know shop safety practices.
2. Use of hand tools.
3. Ability to read.

RESOURCES:

1. Operator's manual for designated tractor.
2. Service manual.

TEACHING ACTIVITIES:

1. Discuss shop safety.
2. Discuss filters, their function, and operation.
3. Discuss relief valves and their function and operation.
4. Discuss proper oil type.
5. Demonstrate filter change procedures.
6. Have students change hydraulic filters on designated tractor.

CRITERION REFERENCED MEASURE:

Practical Application:
Change hydraulic filter on designated tractor.

Method of Evaluating Practical Application:
Using the check list for Performance Objective 143. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 143 EVALUATION

PERFORMANCE TEST FOR CHANGING HYDRAULIC FILTERS

Student's Name **Date**

DIRECTIONS TO STUDENT: Change hydraulic filters on the designated tractor. All steps on the check list must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Checked new filters to be sure they are the proper ones.	______	______
2.	Checked relief valve.	______	______
3.	Removed necessary parts to get to filters.	______	______
4.	Checked manufacturer's recommendations to see if oil should be changed.	______	______
5.	Reassembled and reinstalled all parts removed.	______	______
6.	Checked for leaks.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING HYDRAULICS

PERFORMANCE OBJECTIVE V-TECS 144

TASK: Clean and flush the hydraulic system.

STANDARD OF PERFORMANCE OF TASK:
Flush the hydraulic system on the designated tractor. There will be no damage to the system, flushing will continue until the system is clean and the recommended oil will be used.

SOURCE OF STANDARD:
Fundamentals of Service -- Hydraulics, Deere and Company, Moline, Ill., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Given the manufacturer's service manual, the correct type of hydraulic oil and the tools needed, clean and flush a hydraulic system.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Knowledge of safety concerning hand tools, creepers, and hydraulic pressure.
3. Use of hand tools.

RESOURCES:

1. **Fundamentals of Service -- Hydraulics,** pp. 11-1 thru 11-10.
2. Implement and Tractor Service Manual for specific tractor

TEACHING ACTIVITIES:

1. Discuss the importance of keeping the hydraulic system clean.
2. List and discuss the effects of a dirty hydraulic system on the life of a tractor.
3. Have the students read Chapter 10, pages 1-10 in **Fundamentals of Service — Hydraulics.**
4. Demonstrate how to clean and flush a hydraulic system.
5. Discuss the use of the service manual in determining the procedure for flushing and cleaning the hydraulic system.

CRITERION REFERENCED MEASURE:

Practical Application:
Have student clean and flush hydraulic system using the steps in the performance guide.

Method of Evaluating Practical Application:
Use check list for Performance Objective 144. All steps must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 144 EVALUATION

PERFORMANCE TEST FOR CLEANING AND FLUSHING HYDRAULIC SYSTEM

Student's Name **DATE**

DIRECTIONS TO STUDENT: Clean and flush a hydraulic system on assigned tractor. All steps in the performance guide must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe the students. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Reservoir drained and cleaned.	______	______
2. Filter cleaned or replaced.	______	______
3. Old oil flushed out.	______	______
4. Flushing oil drained out.	______	______
5. Refilled system with clean oil.	______	______
6. Bled air from system.	______	______
7. Checked for leaks.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING HYDRAULICS

PERFORMANCE OBJECTIVE V-TECS 145

TASK: Drain and refill hydraulic system.

STANDARD OF PERFORMANCE OF TASK:
Drain and refill a designated hydraulic system. The system will operate smoothly as determined by the instructor. The oil added will be that recommended by the manufacturer and at the correct level.

SOURCE OF STANDARD:
Fundamentals of Service — Hydraulics, Deere and Company, Moline, Ill., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Given the service manual, new hydraulic oil and the necessary tools, drain and refill the hydraulic system in a clean area.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Knowledge of safety concerning hydraulic pressure, hand tools, and creepers.
3. Use of hand tools.

RESOURCES:

1. **Fundamentals of Service Hydraulics,** pp. 11-1 thru 11-10.
2. Tractor Operator's Manual.

TEACHING ACTIVITIES:

1. Explain to students the importance of changing hydraulic fluid in tractors.
2. Have the students read Chapter 11, pages 1-10 in **Fundamentals of Service — Hydraulics.**
3. Discuss the causes for need to change hydraulic fluid.
4. Demonstrate how to drain and refill the hydraulic system.
5. Have the students list the steps followed in draining and refilling the hydraulic system.

CRITERION REFERENCED MEASURE:

Practical Application:
Have the student drain and refill the hydraulic system. The system will operate smoothly.

Method of Evaluating Practical Application:
Use checklist for Performance Objective 145. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 145 CHECKLIST

PERFORMANCE TEST FOR DRAINING AND REFILLING HYDRAULIC SYSTEM

Student's Name **Date**

DIRECTIONS TO STUDENT: Drain and refill hydraulic system. All steps in the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe students. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Drained oil from system.	______	______
2. Filled system with clean oil.	______	______
3. Cranked engine and bled air from system.	______	______
4. Stopped engine and rechecked oil.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING HYDRAULICS

PERFORMANCE OBJECTIVE V-TECS 146

TASK: Maintain hydraulic cylinders.

STANDARD OF PERFORMANCE OF TASK:
Maintain the cylinders on the specified hydraulic system. All parts will be clean and correctly lubricated. There will be no damage to parts. New seals will be installed where needed and the hydraulic tester will indicate the system functions to specifications.

SOURCE OF STANDARD:
Fundamentals of Service -- Hydraulics, Deere and Company, Moline, Ill., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a hydraulic tester, a service manual, replacement parts as needed, and the necessary tools and lubricants, maintain the hydraulic cylinders.

ENABLING OBJECTIVE(S):

1. Knowledge of safety related to hydraulic pressure and hand tools.
2. Ability to read.
3. Use of hand tools.

RESOURCES:

1. **Fundamentals of Service -- Hydraulics,** pp. 4-7.

TEACHING ACTIVITIES:

1. Discuss the function of hydraulic cylinders.
2. Show the students how to set up hydraulic tester.
3. Demonstrate the correct procedure for rebuilding a hydraulic cylinder.
4. Demonstrate the use of the hydraulic tester.
5. Have the students list the reasons for rebuilding a hydraulic cylinder.

CRITERION REFERENCED MEASURE:

Practical Application:
Provide students with a hydraulic system that has hydraulic cylinders and have them maintain them. All the steps in the checklist must be completed.

Method of Evaluating Practical Application:
Use checklist for Performance Objective 146. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 146 EVALUATION

PERFORMANCE TEST FOR MAINTAINING HYDRAULIC CYCLINDERS

Student's Name **Date**

DIRECTIONS TO STUDENT: Maintain cylinders on hydraulic system. All steps in checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Systems tested with tester.		
2. Cylinder replaced or repaired.		
3. If cylinder repaired checked O-rings.		
4. Tested cylinder after installing it.		
5. Checked for leaks.		
6. Checked internal leakage.		
7. Checked pressure.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING HYDRAULICS

PERFORMANCE OBJECTIVE V-TECS 147

TASK: Operate and analyze with a hydraulic tester.

STANDARD OF PERFORMANCE OF TASK:
Measure the oil flow, pressure, and temperature on the designated tractor. The results of the test will be within 5 percent of the results obtained by the instructor, and all precautions will be taken not to damage any parts.

SOURCE OF STANDARD:
Fundamentals of Service — Hydraulics, Deere and Company, Moline, Ill., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Given an operator's manual, a hydraulic tester, operating instructions and the needed tools, measure the oil flow pressure, and temperature on the designated tractor.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Knowledge of hydraulic safety rules.
3. Use of hand tools.

RESOURCES:

1. **Fundamentals of Service — Hydraulics,** pp. 12-5

TEACHING ACTIVITIES:

1. Explain to students the importance of a hydraulic system operating properly.
2. Demonstrate to students how to set up hydraulic tester.
3. Demonstrate to students how to attach hydraulic tester to a hydraulic system and test the system.
4. Have students list the steps followed in testing the hydraulic system.
5. Have students prepare a form for recording temperature, pressure, and oil flow.

CRITERION REFERENCED MEASURE:
Written test on setting up hydraulic tester and testing the system components.

PERFORMANCE GUIDE:

NOTE: A hydraulic tester (analyzer or test gauge) will measure oil flow, pressure, temperature or isolate faulty components.

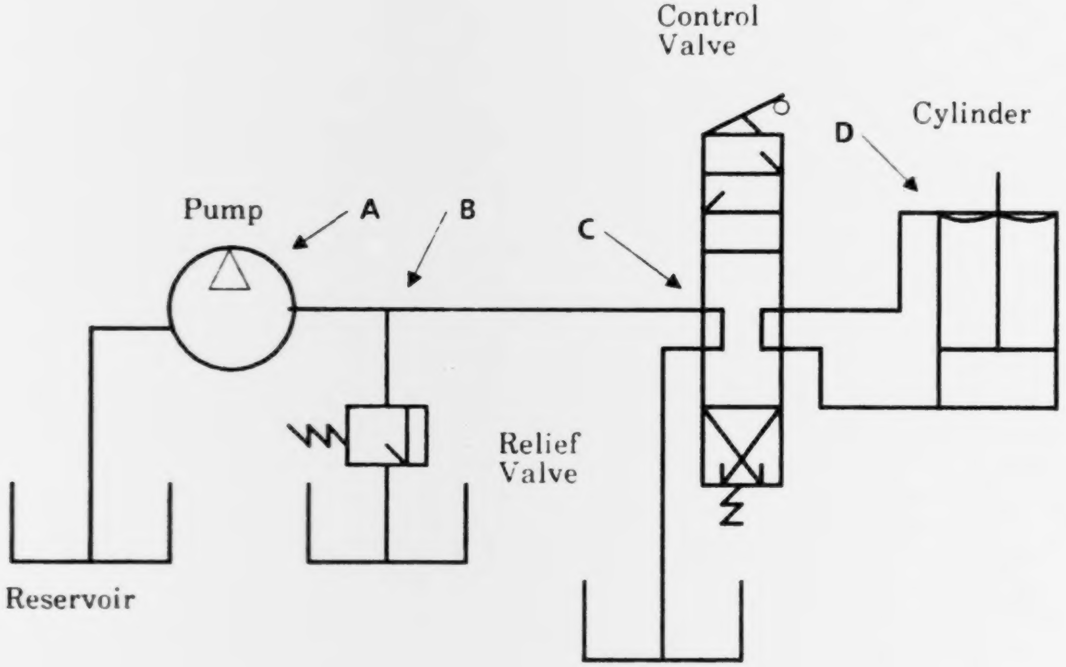
1. Read instruction manual furnished by the manufacturer of the hydraulic tester, and read the service manual of the tractor for specifications on relief valve pressure, pump out put, operating temperature, and engine RPM.
2. Steam clean the machine and plug all openings to keep out dirt.
3. Disconnect the oil lines following instructions from manufacturers of tractor and tester.
4. Connect tester as recommended and check for: temperature, flow, pressure, leakage.
5. To operate the hydraulic tester: With tester load valve open, record the maximum pump flow at no pressure; close the valve slowly to increase pressure. Record the flow at 250 psi increments from no pressure to maximum pressure. Record results: Open hydraulic tester load valve until the maximum pump flow is again at no pressure, and then shut off engine.
6. Analyze with the hydraulic tester: Check manufacturer's specifications and compare readings, especially for pump test. If the pump test is satisfactory, run a system test following manufacturer's instructions and diagnose problems or freedom from problems by comparing results with specifications. NOTE: If flow at each pressure is the same as for the pump test, it means there are no problems with any component. If not and the (a) pressure drops prior to the time full load is reached, one of the circuits is malfunctioning, or (b) if flow drops the same with the control valves in position, the relief valve may be the cause of trouble. Check service manual.

Performance Objective No. 147

Test for Hydraulic Tester

1. List 3 things we need to know to test a hydraulic system.
   - Flow
   - Temperature
   - Pressure

2. Using the illustration, show the places that we need to connect the hydraulic tester to perform the following tests:
   1. Pump test ____
   2. Relief valve ___
   3. Control valve ___
   4. Cylinder (actuator) ___


Control Valve
Cylinder
D
Pump
A
B
C
Relief Valve
Reservoir

DUTY: MAINTAINING AND SERVICING HYDRAULICS

PERFORMANCE OBJECTIVE V-TECS 148

TASK: Repair hydraulic assist transmissions.

STANDARD OF PERFORMANCE OF TASK:
Repair a hydraulic assist transmission on the designated tractor. There will be no damage to any parts. Replacement parts will be those specified by the manufacturer, and the system will function to specifications. All parts will be disassembled and reassembled according to manufacturer's instructions.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist

CONDITIONS FOR PERFORMANCE OF TASK:
Given the manufacturer's service manual, the necessary tools, replacement parts, and testing equipment, repair the hydraulic assist transmission.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Knowledge of hydraulic safety practices.
3. Use of hand tools.

RESOURCES:

1. **Fundamentals of Service -- Power Trains.** pp. 4-1 thru 4-11.

TEACHING ACTIVITIES:

1. Explain to students how hydraulic assist transmissions operate.
2. Demonstrate to students how to trouble shoot hydraulic assist transmissions.
3. Have students read chapter 4, pages 1-11 of **Fundamentals of Service -- Power Trains.**
4. Discuss the procedure used in repairing hydraulic assist transmissions.
5. Demonstrate how to repair a hydraulic assist transmission.

CRITERION REFERENCED MEASURE:

Practical Application:
Have students repair a hydraulic assist transmission. All steps in checklist must be completed.

Method of Evaluating Practical Application:
Use checklist for Performance Objective 148. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 148 EVALUATION

PERFORMANCE TEST FOR REPAIRING HYDRAULIC ASSIST TRANSMISSIONS

Student's Name **Date**

DIRECTIONS TO STUDENT: Repair hydraulic assist transmission on tractor. All steps in the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Attached hydraulic tester to system.	______	______
2. Located problem in system.	______	______
3. System repaired to service manual specifications.	______	______
4. System operates correctly.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING HYDRAULICS

PERFORMANCE OBJECTIVE V-TECS 149

TASK: Repair hydraulic cylinders.

STANDARD OF PERFORMANCE OF TASK:
Repair a hydraulic cylinder on the designated system. All parts will be in working order as shown by testing machine.

SOURCE OF STANDARD:
Fundamentals of Service — Hydraulics, Deere and Company, Moline, Ill., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a hydraulic testing machine, a service manual, replacement parts and the necessary tools, repair a hydraulic cylinder.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Knowledge of hydraulic safety practices.
3. Use of hand tools.

RESOURCES:

1. **Fundamentals of Service — Hydraulics,** pp. 4-8.

TEACHING ACTIVITIES:

1. Discuss the function and operation of hydraulic cylinders.
2. Demonstrate to students how to test hydraulic cylinders.
3. Demonstrate how to repair hydraulic cylinders.
4. Have student list steps followed in testing hydraulic cylinders.
5. List and discuss the reasons for hydraulic cylinder wear.

CRITERION REFERENCED MEASURE:

Practical Application:
Have students repair hydraulic cylinder. All steps in checklist must be completed.

Method of Evaluating Practical Application:
Use checklist for Performance Objective 149. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 149 EVALUATION

PERFORMANCE TEST FOR REPAIRING HYDRAULIC CYLINDERS

Student's Name **Date**

DIRECTIONS TO STUDENT: Repair hydraulic cylinders on a designated system. All steps in checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe students. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1. Cylinder tested with tester.	______	______
2. Cylinder disassembled.	______	______
3. All parts cleaned.	______	______
4. New seals installed.	______	______
5. Seals lubricated.	______	______
6. Cylinder reassembled and installed.	______	______
7. Bled air from system.	______	______
8. Checked installed cylinder for leaks.	______	______
9. Checked cylinder for proper operation.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING HYDRAULICS

PERFORMANCE OBJECTIVE V-TECS 150

TASK: Repair hydraulic motors.

STANDARD OF PERFORMANCE OF TASK:
Repair a damaged or worn out hydraulic motor. Replacement parts will be those recommended by the manufacturer. There will be no damage to parts but all worn or damaged parts will be repaired or replaced. There will be no air or fuel leaks and the motor will operate to specifications. The disassembly and assembly will follow instructions in the service manual.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist

CONDITIONS FOR PERFORMANCE OF TASK:
Given the manufacturer's service manual, the necessary tools and replacement parts, repair a hydraulic motor.

ENABLING OBJECTIVE(S):
1. Knowledge of hydraulic safety.
2. Use of hand tool.
3. Ability to read manual and specifications.

RESOURCES:
1. **Fundamentals of Service — Hydraulics.** pp. 5-1 thru 5-12.

TEACHING ACTIVITIES:
1. Explain to students the types of hydraulic motors.
2. Discuss the principle of operation of hydraulic motor.
3. List and discuss the advantages of hydraulic motors in specific applications.
4. Have the student read chapter 5, pages 1-12 of **Fundamentals of Service — Hydraulics.**
5. Demonstrate the procedure to follow when repairing hydraulic motors.

CRITERION REFERENCED MEASURE:

Practical Application:
Have students repair hydraulic motors. All steps in the checklist must be completed.

Method of Evaluating Practical Application:
Use checklist for Performance Objective 150. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 150 EVALUATION

PERFORMANCE TEST FOR REPAIRING HYDRAULIC MOTORS

Student's Name **Date**

DIRECTIONS TO STUDENT: Repair hydraulic motors. All steps in checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Removed hydraulic motor.		
2. Disassembled motor.		
3. Replaced motor parts.		
4. Seals installed and lubricated.		
5. Motor reassembled.		
6. Checked installed motor for leaks.		
7. Checked for proper operation.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING HYDRAULICS

PERFORMANCE OBJECTIVE V-TECS 151

TASK: Replace hydraulic fittings.

STANDARD OF PERFORMANCE OF TASK:
Replace the hydraulic fitting on the designated tractor. It will be replaced so that it does not leak under operating pressure.

SOURCE OF STANDARD:
Kentucky Writing Team -- Supervisor

CONDITIONS FOR PERFORMANCE OF TASK:
Given a new fitting, the necessary tools and replacement parts, hydraulic fuel and oil, replace the hydraulic fitting.

ENABLING OBJECTIVE(S):

1. Knowledge of hydraulic safety.
2. Use of hand tools.

RESOURCES:

1. **Fundamental of Service - Hydraulics.** pp. 8-9 thru 8-11.

TEACHING ACTIVITIES:

1. Discuss the importance of proper fittings on hydraulic hoses.
2. Demonstrate to students how to replace fittings on hydraulic hoses.
3. Have the students list the causes of fitting failure.

CRITERION REFERENCED MEASURE:

Practical Application:
Have students replace hydraulic fittings on hoses. All steps in checklist must be completed.

Method of Evaluating Practical Application:
Use checklist for Performance Objective 151. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V TECS 151 EVALUATION

PERFORMANCE TEST FOR REPLACING HYDRAULIC FITTINGS

Student's Name **Date**

DIRECTIONS TO STUDENT: Replace hydraulic fittings on hoses. All steps in checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Removed defective fittings.	______	______
2. Replaced fittings on hose.	______	______
3. New fitting has correct threads.	______	______
4. Attached new hose and fitting.	______	______
5. Checked for twisted hose.	______	______
6. Checked for leaks.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature Date

DUTY: MAINTAINING AND SERVICING HYDRAULICS

PERFORMANCE OBJECTIVE V-TECS 152

TASK: Service and adjust hydraulic assist transmissions.

STANDARD OF PERFORMANCE OF TASK:
Service and adjust the hydraulic assist transmission on the designated tractor. All service and adjustments will be according to manufacturer's instructions. There will be no damage to any part and the transmission will operate to specifications.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist

CONDITIONS FOR PERFORMANCE OF TASK:
Given the manufacturer's service manual, the necessary tools, checking equipment, replacement parts as needed, fresh oil, and lubricants, service and adjust a hydraulic assist transmission.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Knowledge of hydraulic safety practice.
3. Use of hand tools.

RESOURCES:

1. **Fundamentals of Service – Power Trains.** pp. 4-1 thru 4-11.

TEACHING ACTIVITIES:

1. Discuss the operation and function of a hydraulic assist transmission.
2. Explain to students the importance of a properly serviced hydraulic assist transmission.
3. Show students how to properly adjust a hydraulic assist transmission.
4. Assign students to read Chapter 4, pages 1-11 in **Fundamentals of Service - Power Trains.**
5. Discuss and list the different types of hydraulic assist transmissions.

CRITERION REFERENCED MEASURE:

Practical Application:
Have student service and adjust hydraulic assist transmissions.

Method of Evaluating Practical Application:
Use checklist for Performance Objective 152. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 152 CHECKLIST

PERFORMANCE TEST FOR SERVICING AND ADJUSTING HYDRAULIC ASSIST TRANSMISSIONS

Student's Name **Date**

DIRECTIONS TO STUDENT: Service and adjust hydraulic assist transmissions. All steps in checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Attached tester to transmission.	______	______
2. Checked for proper operation.	______	______
3. Made repairs or adjustments.	______	______
4. Operated engine and checked system.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING HYDRAULICS

PERFORMANCE OBJECTIVE V-TECS 153

TASK: Service hydraulic pumps.

STANDARD OF PERFORMANCE OF TASK:
Service the hydraulic gear pump on the designated tractor. Clean, disassemble, repair, and reassemble pump according to manufacturer's specifications in 1 1/2 hours.

SOURCE OF STANDARD:
Kentucky Writing Team -- Supervisor

CONDITIONS FOR PERFORMANCE OF TASK:
Using the designated tractor, a set of mechanic's tools, service manual, a micrometer, torque wrench, clean rags, replacement parts, and hydraulic fluid, service the hydraulic gear pump.

ENABLING OBJECTIVE(S):

1. Knowledge of hydraulic safety practices.
2. Use of hand tools.
3. Ability to read.

RESOURCES:

1. **Fundamentals of Service -- Hydraulics.** pp. 2-1 thru 2-13.

TEACHING ACTIVITIES:

1. Discuss the principle of operation of hydraulic pumps.
2. Have students read Chapter 2, pages 1-13 in **Fundamentals of Service — Hydraulics.**
3. Discuss with students the types of hydraulic pumps.
4. Demonstrate how to repair hydraulic pumps.
5. Have students list the types of hydraulic pumps and their appropriate uses.

CRITERION REFERENCED MEASURE:

Practical Application:
Have students service hydraulic pumps. All steps in the checklist must be completed.

Method of Evaluating Practical Application:
Use checklist for Performance Objective 153. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 153 CHECKLIST

PERFORMANCE TEST FOR SERVICING HYDRAULIC PUMPS

Student's Name **Date**

DIRECTIONS TO STUDENT: Service hydraulic pumps. All steps in checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Removed pump and plugged lines.		
2. Cleaned pumps.		
3. Disassembled pump and cleaned.		
4. Checked parts for wear.		
5. Replaced worn parts.		
6. Installed new seals and lubricated them.		
7. Installed pump on machine.		
8. Checked for leaks and proper operation.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING HYDRAULICS

PERFORMANCE OBJECTIVE V-TECS 154

TASK: Service hydraulic pumps.

STANDARD OF PERFORMANCE OF TASK:
Service the radial piston pump on the designated tractor. Rebuild and check the pump so it is within the operating specifications of the manufacturer in both GPM and pressure.

SOURCE OF STANDARD:
Kentucky Writing Team -- Supervisor.

CONDITIONS FOR PERFORMANCE OF TASK:
Using the designated tractor, the correct wrenches, a dial indicator, micrometer, service manual, torque wrench, new parts as required, clean rags, hydraulic fluid, and container for individual sections for pump parts, service a radial piston pump.

ENABLING OBJECTIVE(S):

1. Knowledge of hydraulic safety practices.
2. Use of hand tools.
3. Ability to read.

RESOURCES:

1. **Fundamentals of Service - Hydraulics.** pp. 2-1 thru 2-13.

TEACHING ACTIVITIES:

1. Explain to students how hydraulic pumps operate.
2. Show students how to rebuild hydraulic pumps.
3. Have students read Chapter 2, pages 1-13 in **Fundamentals of Service — Hydraulics.**
4. Discuss and list the uses of the radial piston hydraulic pumps.
5. Discuss the use of the service manual in determining the operational specifications.

CRITERION REFERENCED MEASURE:

Practical Application:
Have student service hydraulic pumps. All steps in checklist must be completed.

Method of Evaluating Practical Application:
Use checklist for Performance Objective 154. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 154 EVALUATION

PERFORMANCE TEST FOR SERVICING HYDRAULIC PUMP

Student's Name **Date**

DIRECTIONS TO STUDENT: Service hydraulic pumps. All steps in checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1.	Removed pump and plugged lines.		
2.	Cleaned pump.		
3.	Disassembled pump and cleaned it.		
4.	Checked parts for wear.		
5.	Replaced worn parts.		
6.	Installed new seals and lubricated them.		
7.	Assembled pump.		
8.	Installed pump on machine.		
9.	Checked for leaks and proper operation.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING HYDRAULICS

PERFORMANCE OBJECTIVE V-TECS 155

TASK: Service hydraulic motors.

STANDARD OF PERFORMANCE OF TASK:
Service the designated hydraulic motor. All parts will be cleaned and worn or damaged parts replaced. The pressure, speed, torque, displacement, load and temperature will be adjusted to manufacturer's specifications.

SOURCE OF STANDARD:
Kentucky Writing Team -- Supervisor.

CONDITIONS FOR PERFORMANCE OF TASK:
Given the manufacturer's service manual, testing equipment, the necessary tools and replacement parts, and fresh oil, service a hydraulic motor.

ENABLING OBJECTIVE(S):

1. Knowledge of hydraulic safety.
2. Ability to read.
3. Use of hand tools.

RESOURCES:

1. **Fundamentals of Service -- Hydraulics.** Deere and Company, pp. 5-1 thru 5-11.

TEACHING ACTIVITIES:

1. Discuss the types of hydraulic motors.
2. Show students examples of hydraulic motors and discuss their applications.
3. Demonstrate the disassembly procedure for hydraulic motor.
4. Using the service manual show the student how you determine if motor parts must be replaced.
5. Demonstrate the repair and reassembly of hydraulic motors.
6. Demonstrate the testing procedure for a repaired hydraulic motor.

CRITERION REFERENCED MEASURE:

Practical Application:
Have students service hydraulic motors. All steps in the checklist must be completed.

Method of Evaluating Practical Application:
Use checklist for Performance Objective 155. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 155 EVALUATION

PERFORMANCE TEST FOR SERVICING HYDRAULIC MOTORS

Student's Name **Date**

DIRECTIONS TO STUDENT: Service hydraulic motors. All steps in checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide need supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Set up tester and checked motor.	____	____
2. Disassembled motor.	____	____
3. Cleaned parts.	____	____
4. Inspected for wear and damage.	____	____
5. Replaced worn parts.	____	____
6. Installed new seals and lubricated them.	____	____
7. Reassembled motor.	____	____
8. Installed motor.	____	____
9. Checked for leaks and operation.	____	____

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING HYDRAULICS

PERFORMANCE OBJECTIVE V-TECS 156

TASK: Service hydrostatic drive.

STANDARD OF PERFORMANCE OF TASK:
Service the designated hydrostatic drive system. All parts will be disassembled and reassembled following manufacturer's instructions. Working area and all parts will be clean. No dirt, lint, or chaff will enter the system and the system will operate to manufacturer's specifications with no leakage.

SOURCE OF STANDARD:
Fundamentals of Service — Power Trains. Deere and Company, Moline, Ill., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Given the manufacturer's service manual, steam cleaning equipment, the necessary clean and grease free tools and supplies, a clean working area, and replacement parts and oil, service a hydrostatic drive pump and motor.

ENABLING OBJECTIVE(S):
1. Knowledge of hydraulic safety practices.
2. Ability to read.
3. Use of hand tools.

RESOURCES:
1. **Fundamentals of Service — Power Trains.** pp. 5-1 thru 5-14.

TEACHING ACTIVITIES:
1. Explain to students how hydrostatic drives operate.
2. Show students how to test hydrostatic drives.
3. Discuss and list the advantages and disadvantages of hydrostatic drives.
4. Demonstrate the procedure for servicing a hydrostatic drive.
5. Have students list the steps followed in servicing a hydrostatic drive.

CRITERION REFERENCED MEASURE:

Practical Application:
Have students repair hydrostatic drive. All steps in checklist must be completed.

Method of Evaluating Practical Application:
Use checklist for Performance Objective 156. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 156 EVALUATION

PERFORMANCE TEST FOR SERVICING HYDROSTATIC DRIVE

Student's Name **Date**

DIRECTIONS TO STUDENT: Service a hydrostatic drive. All steps in checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory. Hydrostatic drive must shift smoothly.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Tested system using service manual.		
2.	Disassembled motor following service manual directions.		
3.	Cleaned and inspected all parts.		
4.	Replaced worn or damaged parts.		
5.	Reassembled motor following service manual directions.		
6.	Replaced oil and filled to proper level.		
7.	Tested system, adjusted if needed.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING HYDRAULICS

PERFORMANCE OBJECTIVE V-TECS 157

TASK: Service and repair hydraulic pumps.

STANDARD OF PERFORMANCE OF TASK:
Service and repair the designated hydraulic pump. There will be no damage to any parts. No dirt, lint or chaff will enter the system and the pump will operate as specified.

SOURCE OF STANDARD:
Fundamentals of Service — Hydraulics. Deere and Company, Moline, Ill., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Given the manufacturer's service manual, a clean working area, and the necessary tools, replacement parts, and fluids, service and repair a hydraulic pump.

ENABLING OBJECTIVE(S):

1. Knowledge of hydraulic safety practices.
2. Ability to read.
3. Use of hand tools.

RESOURCES:

1. **Fundamentals of Service — Hydraulics.** pp. 2-1 thru 2-20.

TEACHING ACTIVITIES:

1. Discuss the three types of hydraulic pumps.
2. Show students examples of the three types of pumps.
3. Discuss and list the uses of the three types of pumps.
4. Discuss and list the advantages and disadvantages of each type of pump.
5. Demonstrate the procedures used in the repair of each pump type.

CRITERION REFERENCED MEASURE:

Practical Application:
Have student service and repair hydraulic pumps. All steps in the checklist must be completed.

Method of Evaluating Practical Application:
Use checklist for Performance Objective 157. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 157 EVALUATION

PERFORMANCE TEST FOR SERVICING AND REPAIRING HYDRAULIC PUMPS

Student's Name **Date**

DIRECTIONS TO STUDENT: Service and repair hydraulic pumps. All steps in checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Removed pump and plugged lines.		
2.	Cleaned pump.		
3.	Disassembled pump and cleaned it.		
4.	Checked parts for wear.		
5.	Replaced worn parts.		
6.	Installed new seals and lubricated seals.		
7.	Assembled pump.		
8.	Installed pump.		
9.	Checked for leaks and operation.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING HYDRAULICS

PERFORMANCE OBJECTIVE V-TECS 158

TASK: Service and repair hydraulic valves

STANDARD OF PERFORMANCE OF TASK:
Service and repair the hydraulic valves on the designated tractor. When service is completed, hydraulic circuits will work to within 10 percent of manufacturer's specifications.

SOURCE OF STANDARD:
Kentucky Writing Team -- Supervisor.

CONDITIONS FOR PERFORMANCE OF TASK:
Using a designated tractor, correct wrenches, service manual, a micrometer, a hand hydraulic pump with pressure gauge, fittings to attach pump to valve, hydraulic fluid, repair parts, and clean rags, service and repair hydraulic valves in a clean work area.

ENABLING OBJECTIVE(S):

1. Knowledge of hydraulic safety practices.
2. Use of hand tools.
3. Ability to read.

RESOURCES:

1. **Fundamentals of Service-Hydraulics.** pp. 3-2 thru 3-18.

TEACHING ACTIVITIES:

1. Discuss the types of hydraulic control valves.
2. Show examples of control valves to the students.
3. List the different types of control valves and discuss their uses.
4. Have student read Chapter 3, pages 2-18 in **Fundamentals of Service -- Hydraulics.**
5. Demonstrate the repair procedure for each type of valve.

CRITERION REFERENCED MEASURE:

Practical Application:
Have student service and repair hydraulic valves. All steps in the checklist must be completed.

Method of Evaluating Practical Application:
Use checklist for Performance Objective 158. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 158 EVALUATION

PERFORMANCE TEST FOR SERVICING AND REPAIRING HYDRAULIC VALVES

Student's Name **Date**

DIRECTIONS TO STUDENT: Service and repair hydraulic valves. All steps in checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Removed valve and plugged lines.		
2.	Cleaned valve.		
3.	Disassembled valve and cleaned.		
4.	Replaced worn or damaged parts.		
5.	Installed new seals and lubricated them.		
6.	Assembled valve.		
7.	Installed valve on machine.		
8.	Checked for leaks and operation.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING HYDRAULICS

PERFORMANCE OBJECTIVE V-TECS 159

TASK: Service and repair internal gear hydraulic pump.

STANDARD OF PERFORMANCE OF TASK:
Service and repair the designated internal gear hydraulic pump. There will be no damage to parts. All parts will be clean and correctly reassembled, in good working order, and the pump will function as specified by the manufacturer.

SOURCE OF STANDARD:
Fundamentals of Service — Hydraulics. Deere and Company, Moline, Ill., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Given the manufacturer's service manual, a clean working area, the necessary tools and replacement parts, solvents, and replacement fluid, service and repair an internal gear hydraulic pump.

ENABLING OBJECTIVE(S):

1. Knowledge of hydraulic safety practices.
2. Ability to read.
3. Use of hand tools.

RESOURCES:

1. **Fundamentals of Service -- Hydraulics.** pp. 2-1 thru 2-5.

TEACHING ACTIVITIES:

1. Discuss types of hydraulic pumps with class.
2. Show students how to disassemble an internal gear pump.
3. List the uses of the types of pumps discussed.
4. Demonstrate the repair procedure for an internal gear pump.
5. Assign students to read Chapter 2, pages 1-5, in **Fundamentals of Service — Hydraulics.**

CRITERION REFERENCED MEASURE:

Practical Application:
Have student service and repair internal gear hydraulic pump.

Method of Evaluating Practical Application:
Use checklist for Performance Objective 159. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 159 EVALUATION

PERFORMANCE TEST FOR SERVICING AND REPAIRING INTERNAL HYDRAULIC PUMP

Student's Name **Date**

DIRECTIONS TO STUDENT: Service and repair internal gear hydraulic pump. All steps in checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1.	Removed pump from machine and plugged lines.		
2.	Cleaned pump.		
3.	Disassembled pump and cleaned it.		
4.	Replaced worn or damaged parts.		
5.	Installed new seals and lubricated them.		
6.	Assembled pump.		
7.	Installed pump on machine.		
8.	Checked for leaks and operation.		

APPROVED: Yes _____ No _______

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING HYDRAULICS

PERFORMANCE OBJECTIVE V-TECS 160

TASK: Trouble-shoot a hydraulic-assist transmission.

STANDARD OF PERFORMANCE OF TASK:
Trouble-shoot the designated hydraulic assist transmission. There will be no damage to any parts. Replacement parts will be those specified by the manufacturer and the transmission will operate to specifications.

SOURCE OF STANDARD:
Fundamentals of Service — Power Trains. Deere and Company, Moline, Ill., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Given the manufacturer's service manual, the necessary tools, checking equipment and replacement parts, trouble-shoot a hydraulic-assist transmission.

ENABLING OBJECTIVE(S):

1. Ability to read.
2. Knowledge of hydraulic safety practices.
3. Use of hand tools.

RESOURCES:

1. **Fundamentals of Service — Power Trains.** pp. 4-2 thru 4-11.

TEACHING ACTIVITIES:

1. Set up hydraulic tester on hydraulic assist transmission and show students how to trouble shoot the system.
2. Discuss the operation of the hydraulic assist transmission.
3. Have students read Chapter 4, pages 2-11, in **Fundamentals of Service — Power Trains.**
4. Have the students list the steps followed in the trouble shooting procedure.

CRITERION REFERENCED MEASURE:

Practical Application:
Have student trouble shoot hydraulic assist transmission. All steps in checklist must be completed.

Method of Evaluating Practical Application:
Use checklist for Performance Objective 160. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 160 EVALUATION

PERFORMANCE TEST FOR TROUBLE SHOOTING HYDRAULIC ASSIST TRANSMISSION

Student's Name ____________________ **Date** __________

DIRECTIONS TO STUDENT: Trouble shoot hydraulic assist transmission. All steps in checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1. Attached hydraulic tester.	________	________
2. Cranked engine and let it warm up.	________	________
3. Trouble-shoot system.	________	________
4. Made repairs or adjustments.	________	________
5. Unhooked hydraulic tester.	________	________
6. Field tested tractor.	________	________

APPROVED: Yes _____ No _____

Evaluator's Signature ____________________ **Date** __________

MAINTAINING AND SERVICING POWERTRAIN

DUTY: MAINTAINING AND SERVICING POWERTRAIN

PERFORMANCE OBJECTIVE V-TECS 161

TASK: Measure backlash and clearance in gear train.

STANDARD OF PERFORMANCE OF TASK:
On the designated tractor, measure the backlash and clearance in the gear train. The dial indicator readings will agree with the instructor's readings. Shims will be correctly installed and final adjustment will be to specifications. Disassembly and reassembly will follow manufacturer's instructions.

SOURCE OF STANDARD:
Fundamentals of Service — Power Trains. Deere and Company, Moline, Ill., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a gear train with too much backlash, a dial indicator, shims, the service manual and the necessary tools, measure the backlash and clearance in a gear train.

ENABLING OBJECTIVE(S):
1. Know shop safety.
2. Ability to read.
3. Use of hand tools.

RESOURCES:
1. Operator's manual.
2. Service manual.

TEACHING ACTIVITIES:
1. Discuss shop safety.
2. Discuss dial indicators and their uses.
3. Discuss backlash and explain what causes it.
4. Demonstrate how to move dial indicator measurements.
5. Demonstrate how to measure backlash and clearance in gear train.

CRITERION REFERENCED MEASURE:

Practical Application:
Have students measure backlash and clearance in gear train.

Method of Evaluating Practical Application:
Using the checklist for Performance Objective 161, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 161 EVALUATION

PERFORMANCE TEST FOR MEASURING BACKLASH AND CLEARANCE IN GEAR TRAIN

Student's Name **Date**

DIRECTIONS TO STUDENT: Measure backlash and clearance in gear train of designated tractor. Dial indicator readings will agree with the instructor's readings. Shims will be correctly installed and final adjustment will be to manufacturer's specifications. All items on the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Followed instructions in service manual to reach gear train.		
2.	Cleaned all parts.		
3.	Mounted dial indicator properly.		
4.	Adjusted backlash reading to proper specifications with shims.		
5.	Reassembled all parts according to manufacturer's instructions and specifications.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING POWERTRAIN

PERFORMANCE OBJECTIVE V-TECS 162

TASK: Measure end-play movement in gear shaft.

STANDARD OF PERFORMANCE OF TASK:
Measure the end-play movement in the gear shaft of the powertrain on the designated tractor. The dial indicator readings will agree with those of the instructor, and adjustments will be to manufacturer's specifications. Disassembly and reassembly will follow manufacturer's instructions.

SOURCE OF STANDARD:
Fundamentals of Service — Power Trains. Deere and Company, Moline, Ill., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a gear shaft with too much end play, the service manual, dial indicator, shims, and the necessary tools, measure the end-play movement in the gear shaft.

ENABLING OBJECTIVE(S):

1. Know shop safety practices.
2. Ability to read.
3. Use of hand tools.

RESOURCES:

1. Operator's manual for designated tractor.
2. Service manual.
3. **Fundamentals of Service — Power Trains.** pp. 136-142.

TEACHING ACTIVITIES:

1. Discuss shop safety.
2. Discuss power trains and their function.
3. Discuss dial indicators and their uses.
4. Discuss preloading.
5. Demonstrate measuring with dial indicators.
6. Demonstrate preloading.
7. Demonstrate how to measure end-play movement in gear shaft.

CRITERION REFERENCED MEASURE:

Practical Application:
Measure the end-play movement in the gear shaft of the powertrain of the designated tractor. The dial indicator readings will agree with those of the instructor. Adjust according to manufacturer's specifications.

Method of Evaluating Practical Application:
Using the checklist for Performance Objective 162. All items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 162 EVALUATION

PERFORMANCE TEST FOR MEASURING END-PLAY MOVEMENT IN GEAR SHAFT

Student's Name **Date**

DIRECTIONS TO STUDENT: Measure end-play movement in gear shaft. Dial indicator measurements must agree with instructor's measurements. All steps on the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Followed instructions in the manufacturer's service manual to reach gears and shaft.		
2. Mounted dial indicator properly.		
3. Read readings properly.		
4. Adjusted end play.		
5. Optional if necessary -- loaded the gear train to take up slack.		
6. Reassembled and reinstalled all parts taken off.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING POWERTRAIN

PERFORMANCE OBJECTIVE V-TECS 163

TASK: Preload bearings in gear train.

STANDARD OF PERFORMANCE OF TASK:
Preload the bearings in the gear train of the designated tractor. Disassembly and reassembly will be according to service manual, shims will be correctly installed and adjusted. Final dial indicator readings will agree with those of the instructor and will be to manufacturer's specifications.

SOURCE OF STANDARD:
Fundamentals of Service -- Power Trains. Deere and Company, Moline, Ill., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a gear train which needs preloading, the manufacturer's service manual, shims, a dial indicator and the necessary tools, preload the bearings in the gear train.

ENABLING OBJECTIVE(S):

1. Know shop safety practices.
2. Use of hand tools.
3. Ability to read.

RESOURCES:

1. Operator's manual for designated tractor.
2. Service manual.
3. **Fundamentals of Service -- Power Trains.** pp. 130-136.

TEACHING ACTIVITIES:

1. Discuss shop safety.
2. Discuss preloading and the need for it.
3. Discuss dial indicator.
4. Demonstrate preloading of bearings in gear train.
5. Demonstrate how to make dial indicator measurements.
6. Have students preload bearings in gear train.

CRITERION REFERENCED MEASURE:

Practical Application:
Preload bearings in power train.

Method of Evaluating Practical Application:
Using the checklist for Performance Odbjective 163, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 163 EVALUATION

PERFORMANCE TEST FOR PRELOADING BEARINGS IN GEAR TRAIN

Student's Name **Date**

DIRECTIONS TO STUDENT: Preload bearings in gear train of designated tractor. Disassembly and reassembly will be according to service manual, shims will be correctly installed and adjusted. Final dial indicator readings will agree with those of the instructor. All items on the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Checked manufacturer's service manual for designated tractor, and followed instructions to reach ring gear and pinion.		
2. Checked needed adjustments with dial indicator.		
3. Adjusted with shims and adjusting nuts.		
4. Reassembled and adjusted to specifications.		
5. Adjusted the pinion to the ring gear with shims under lower shaft bearing.		
6. Used shims under the upper shaft bearing to preload pinion shaft bearings.		
7. Checked end play and removed shims necessary to equal the end play plus specified loads.		
8. Preloaded ring gear bearings with shims under the slide quills.		
9. Installed extra shims, checked end play, and removed shims to equal end play and recommended preload for bearing.		
10. Transferred shims under the side quills to adjust backlash, and checked backlash at several points around the ring gear.		

PERFORMANCE OBJECTIVE V-TECS 163 CHECKLIST (Continued)

11. Consulted service manual for exact steps to be followed and readings. ________ ________

12. Reassembled according to manufacturer's directions. ________ ________

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING POWERTRAIN

PERFORMANCE OBJECTIVE V-TECS 164

TASK: Service constant mesh transmission (Ford).

STANDARD OF PERFORMANCE OF TASK:
Service the constant mesh transmission on the designated tractor. All parts should be clean and reassembled correctly with no damage to any parts, properly torqued and lubricated and functioning to manufacturer's specifications. Disassembly and reassembly will be performed in order specified by the manufacturer according to specifications.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given the necessary tools, equipment and supplies and the manufacturer's service manual, service a constant mesh transmission.

ENABLING OBJECTIVE(S):

1. Know shop safety.
2. Use of hand tools.
3. Ability to read.

RESOURCES:

1. Operator's manual for designated tractor.
2. Service manual.

TEACHING ACTIVITIES:

1. Discuss shop safety.
2. Discuss constant mesh transmissions and their operation.
3. Discuss disassembly and reassembly of output and counter shafts.
4. Discuss torque wrenches.
5. Discuss jacks, engine stands and components.
6. Discuss service manual as to assembly and disassembly of tractor.
7. Demonstrate torque wrench.
8. Demonstrate disassembly and reassembly of output shaft and countershaft.
9. Demonstrate proper disassembly and reassembly of a constant mesh transmission.
10. Have students service constant mesh transmission.

CRITERION REFERENCED MEASURE:

Practical Application:
Service constant mesh transmission.

Method of Evaluating Practical Application:
Using the checklist for Performance Objective 164, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 164 EVALUATION

PERFORMANCE TEST FOR SERVICING CONSTANT MESH TRANSMISSION

Student's Name **Date**

DIRECTIONS TO STUDENT: Service constant mesh transmission for designated tractor. All parts properly torqued to manufacturer's specifications. All steps on checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	**Satisfactory**	**Unsatisfactory**
1.	Removed transmission according to service manual.		
2.	Removed shifter fork.		
3.	Removed clutch release bearing support.		
4.	Removed shifter rail.		
5.	Removed the shaft bearing retainer, kept shims for reassembly.		
6.	Removed output shaft gear assembly.		
7.	Removed shifter rail.		
8.	Removed PTO support and shifter assembly, kept shims together for reassembly.		
9.	Removed countershaft assembly, reverse shifter rail spring seat, gasket, spring and detent ball from left side of transmission case.		
10.	Loosened lock nut in reverse gear shift fork and backed off lock screw.		
11.	Pulled the reverse gearshift rail out of the housing.		
12.	Removed shifter fork.		
13.	Pulled reverse idler shaft.		
14.	Cleaned all parts in suitable solvent.		

PERFORMANCE OBJECTIVE V-TECS 164 CHECKLIST (Continued)

15. Inspected all parts and replaced all worn and defective ones. ______ ______

16. Lubricated parts. ______ ______

17. Disassembled and assembled output shaft. ______ ______

18. Disassembled and assembled countershaft. ______ ______

19. Checked the output shaft with a cord and pull scale. ______ ______

20. Reassembled all parts according to operator's service manual until constant mesh transmission worked properly.

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING POWERTRAIN

PERFORMANCE OBJECTIVE V-TECS 165

TASK: Service power-shift transmission

STANDARD OF PERFORMANCE OF TASK:
Service the power-shift transmission on the designated tractor. All parts disassembled and reassembled will follow the instructions and meet the specifications given in the service manual. All excessively worn or defective parts will be replaced.

SOURCE OF STANDARD:
Fundamentals of Service — Power Trains. Deere and Company, Moline, Ill., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Given the manufacturer's service manual, solvents, oil, replacement parts and the necessary tools and checking equipment, service a power-shift transmission.

ENABLING OBJECTIVE(S):

1. Know shop safety practices.
2. Ability to read.
3. Use of hand tools.

RESOURCES:

1. Operator's manual.
2. Service manual.
3. **Tractor Operation and Daily Care,** pp. 1-84.

TEACHING ACTIVITIES:

1. Discuss shop safety.
2. Discuss power shift transmissions -- principles and functions.
3. Discuss oils and solvents.
4. Discuss and demonstrate removal and replacement of transmission.
5. Demonstrate how tolerances for worn or defective parts are determined.
6. Have students service powershift transmission on the designated tractor.

CRITERION REFERENCED MEASURE:

Practical Application:
Service power-shift transmission in a designated tractor.

Method of Evaluating Practical Application:
Using the checklist for Performance Objective 165, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 165 EVALUATION

PERFORMANCE TEST FOR SERVICING POWER-SHIFT TRANSMISSION

Student's Name **Date**

DIRECTIONS TO STUDENT: Service the power-shift transmissions in the designated tractor. All parts must meet manufacturer's specifications. All steps on the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Checked service manual for proper disassembly and reassembly.	________	________
2. Removed transmission properly.	________	________
3. Inspected for worn gear teeth, bearings.	________	________
4. Inspected for broken springs and detent balls.	________	________
5. Inspected for plugged transmission oil lines.	________	________
6. Reassembled according to manufacturer's specifications.	________	________

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING POWERTRAIN

PERFORMANCE OBJECTIVE V-TECS 166

TASK: Service sliding-gear transmission.

STANDARD OF PERFORMANCE OF TASK:
Service the sliding-gear transmission on the designated tractor. All parts will be clean and operate to manufacturer's specifications, and replacement parts will be installed where necessary. Disassembly and reassembly will follow manufacturer's instructions.

SOURCE OF STANDARD:
Fundamentals of Service -- Power Trains. Deere and Company, Moline, Ill., 1972.

CONDITIONS FOR PERFORMANCE OF TASK:
Given the manufacturer's service manual, oil, needed replacement parts, the tools and equipment stated in the service manual, service a sliding-gear transmission.

ENABLING OBJECTIVE(S):

1. Know shop safety.
2. Ability to read.
3. Use of hand tools.

RESOURCES:

1. Operator's manual.
2. Service manual.
3. **Fundamentals of Service -- Power Trains,** pp. 130-142.

TEACHING ACTIVITIES:

1. Discuss shop safety.
2. Discuss sliding gear transmissions -- principle and function.
3. Discuss oils.
4. Discuss disassembly and reassembly procedures.
5. Demonstrate how to service sliding-gear transmission.

CRITERION REFERENCED MEASURE:

Pratical Application:
Service sliding-gear transmission.

Method of Evaluating Practical Application:
Using the checklist for Performance Objective 166, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 166 EVALUATION

PERFORMANCE TEST FOR SERVICING SLIDING-GEAR TRANSMISSION

Student's Name **Date**

DIRECTIONS TO STUDENT: Service the sliding-gear transmission in the designated tractor. Worn and defective parts must be replaced to follow manufacturer's specifications. All steps on the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Checked service manual for proper disassembly and reassembly.	________	________
2. Removed transmission properly.	________	________
3. Inspected gear teeth and bearings for wear and breaks, replaced as needed.	________	________
4. Inspected for defective or plugged transmission oil lines.	________	________
5. Inspected for broken or distorted detent springs and balls.	________	________
6. Reassembled all parts and replaced transmission according to manufacturer's specifications.	________	________

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

MAINTAINING AND SERVICING DIFFERENTIALS

DUTY: MAINTAINING AND SERVICING DIFFERENTIALS

PERFORMANCE OBJECTIVE V-TECS 167

TASKS: Correct adjustment of ring gear and pinion.

STANDARD OF PERFORMANCE OF TASK:
Correct the adjustment of the ring gear and pinion on the designated tractor. The adjustments will be to manufacturer's specifications, all parts will be reassembled and installed according to manufacturer's directions, and there will be no damage to any parts.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given a service manual for the tractor being used, a complete set of mechanic's tools, and a dial indicator, correct the adjustment of the ring gear and pinion on the differentials.

ENABLING OBJECTIVE(S):

1. Know shop safety.

RESOURCES:

1. Operator's manual.
2. Service manual.

TEACHING ACTIVITIES:

1. Discuss shop safety.
2. Discuss dial indicators.
3. Demonstrate the use of dial indicators.
4. Discuss ring gear and pinion, their function and purpose.
5. Demonstrate proper adjustment of ring gear and pinion.
6. Have students correct the adjustment of ring gear and pinion.

CRITERION REFERENCED MEASURE:

Practical Application:
Have students correct adjustment of ring gear and pinion.

Method of Evaluating Practical Application:
Using the checklist for Performance Objective 167, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 167 EVALUATION

PERFORMANCE TEST FOR CORRECTING ADJUSTMENT OF RING GEAR AND PINION

Student's Name **Date**

DIRECTIONS TO STUDENT: Correct adjustment of ring gear and pinion on the designated tractor. All adjustments will be to manufacturer's specifications. All items on the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items on the checklist must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Followed instructions in the service manual to gain access to ring gear and pinion.		
2. Used dial indicator properly and checked ring gear backlash at several locations.		
3. Checked readings against manufacturer's specifications.		
4. Reassembled and reinstalled all parts as per manufacturer's specifications.		

APPROVED: Yes _____ No _____

Evaluator's Signature Date

DUTY: MAINTAINING AND SERVICING DIFFERENTIALS

PERFORMANCE OBJECTIVE V-TECS 168

TASK: Preload bearings.

STANDARD OF PERFORMANCE OF TASK:
Preload the bearings on the axle shaft of the designated tractor. The correct spacer as outlined in the service manual will be used, the dial indicator reading will be the same as the instructor's, and all parts will be reassembled according to manufacturer's instructions with no parts damaged.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Using a designated tractor and the service manual, a set of spacers, and all necessary tools, preload the bearings on the axle shaft.

ENABLING OBJECTIVE(S):
1. Know shop safety.
2. Use hand tools.

RESOURCES:
1. Operator's manual.
2. Service manual.

TEACHING ACTIVITIES:
1. Discuss shop safety.
2. Discuss dial indicators.
3. Discuss preloading and the need for preloading..
4. Demonstrate the use of dial indicators.
5. Demonstrate the procedure for preloading bearings.
6. Have students preload bearings.

CRITERION REFERENCED MEASURE:

Practical Application:
Have student preload bearings.

Method of Evaluating Practical Application:
Using checklist for Performance Objective 168, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 168 EVALUATION

PERFORMANCE TEST FOR PRELOADING BEARINGS

Student's Name **Date**

DIRECTIONS TO STUDENT: Preload bearings on the axle shaft of designated tractor. Dial indicator readings will be the same as the instructor's. All work will be done according to manufacturer's specifications. All items on the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Followed manufacturer's instructions to reach axle shaft bearing.	____	____
2. Used proper spacer.	____	____
3. Used proper retaining washer and tightened the axle shaft bolt according to specifications.	____	____
4. Set up dial indicator properly.	____	____
5. Determined correct bearing preload and subtracted readings properly.	____	____
6. Checked specifications and installed correct spacer.	____	____
7. Reassembled all parts according to manufacturer's instructions in the service manual.	____	____

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING DIFFERENTIALS

PERFORMANCE OBJECTIVE V-TECS 169

TASK: Repair differentials.

STANDARD OF PERFORMANCE OF TASK:
Repair the differentials on the designated tractor. All parts will be clean and lubricated when specified. All parts will be torqued to specifications. Disassembly and reassembly will be in the order specifed in the service manual.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist

CONDITIONS FOR PERFORMANCE OF TASK:
Given the service manual for the tractor to be repaired and the necessary tools and equipment, repair the differentials.

ENABLING OBJECTIVE(S):

1. Know shop safety.
2. Use hand tools.
3. Ability to read.

RESOURCES:

1. Operator's manual.
2. Service manual.

TEACHING ACTIVITIES:

1. Discuss shop safety and the use of jacks and supports.
2. Discuss the function and purpose of differentials.
3. Discuss designated tractor and disassembly and reassembly of differential and final drive.
4. Demonstrate what to look for in worn or broken parts and demonstrate use of torque wrench.
5. Have students repair differential on designated tractor.

CRITERION REFERENCED MEASURE:

Practical Application:
Have students repair differential.

Method of Evaluating Practical Application:
Using the checklist for Performance Objective 169, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 169 EVALUATION

PERFORMANCE TEST FOR REPAIRING DIFFERENTIALS

Student's Name **Date**

DIRECTIONS TO STUDENT: Repair differential on designated tractor. All parts will be torqued to specifications. All items on the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items on the checklist must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Checked service manual for proper sequence of disassembly.		
2.	Properly prepared tractor for disassembly.		
3.	Removed component parts in proper sequence.		
4.	Inspected bearing cones and cups to determine wear.		
5.	Checked all parts and bearings for wear and replaced necessary parts.		
6.	Torqued cap screws to 45-50 ft. lbs.		
7.	Reassembled all parts in the reverse order removed, checked service manual for specifications.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING DIFFERENTIALS

PERFORMANCE OBJECTIVE V-TECS 170

TASK: Replace brake and axle seals and gaskets.

STANDARD OF PERFORMANCE OF TASK:
Replace the brake and axle seals and gaskets on the designated tractor. All seals and gaskets will be the right ones for their location and will show no signs of leaks. All parts will be reassembled to manufacturer's instructions and specifications, and there will be no damage to any parts.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Using a designated tractor and the manufacturer's service manual, new gaskets and seals, and the necessay tools, equipment, and supplies, replace the brake and axle seals and gaskets.

ENABLING OBJECTIVE(S):

1. Know shop safety.
2. Ability to read.
3. Use of hand tools.

RESOURCES:

1. Operator's manual.
2. Service manual.

TEACHING ACTIVITIES:

1. Discuss shop safety.
2. Discuss seals and gaskets and their purpose and function.
3. Demonstrate proper method of replacing seals and gaskets.
4. Have student list the steps followed when replacing gaskets and seals.
5. Have students replace brake and axle seals and gaskets.

CRITERION REFERENCED MEASURE:

Practical Application:
Replace brake and axle seals and gaskets.

Method of Evaluating Practical Application:
Using a checklist for Performance Objective 170, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 170 EVALUATION

PERFORMANCE TEST FOR REPLACING BRAKE AND AXLE SEALS AND GASKETS

Student's Name **Date**

DIRECTIONS TO STUDENT: Replace brake and axle seals and gaskets on the designated tractor. All seals and gaskets will be the right ones and will have no leaks. All parts will be reassembled to manufacturer's specifications and instructions. All items on the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items on the checklist must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Followed instructions in service manual to reach seals and gaskets.	______	______
2. Removed old seals and gaskets and cleaned metal thoroughly.	______	______
3. Installed new seals and gaskets properly.	______	______
4. Reassembled according to manufacturer's instructions and specifications.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING DIFFERENTIALS

PERFORMANCE OBJECTIVE V-TECS 171

TASK: Service differential locks (mechanical, hydraulics)

STANDARD OF PERFORMANCE OF TASK:
Service the differential locks on the designated tractor. All worn or damaged parts will be repaired or replaced according to manufacturer's specifications. All parts will be clean on visual inspection. The differential locks will be disassembled and reassembled in the order specified in the service manual.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Using a designated tractor and the service manual, the necessary tools, supplies, and replacement parts, service the differential locks (mechanical and hydraulic).

ENABLING OBJECTIVE(S):

1. Know shop safety.
2. Use hand tools.
3. Be able to read.

RESOURCES:

1. Operator's manual.
2. Service manual.

TEACHING ACTIVITIES:

1. Discuss shop safety.
2. Discuss differential locks and their function and purpose.
3. Discuss disassembly of differential and differential locks.
4. Discuss reassembly of differential and differential locks.
5. Have student service differential locks (mechanical, hydraulic).

CRITERION REFERENCED MEASURE:

Practical Application:
Have students service differential locks both mechanical and hydraulic.

Method of Evaluating Practical Application:
Using a checklist for Performance Objective 171, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 171 CHECKLIST

PERFORMANCE TEST FOR SERVICING DIFFERENTIAL LOCKS (MECHANICAL, HYDRAULIC)

Student's Name **Date**

DIRECTIONS TO STUDENT: Service the differential locks on the designated tractor. All worn or damaged parts will be replaced. Disassemble and reassemble will be according to the order in the service manual. All items on the checklist must be completed.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items on the checklist must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Checked service manual for sequence to be followed.	______	______
2.	Performed differential lock adjustment properly.	______	______
3.	Checked service manual for proper overhaul of differential assembly.	______	______
4.	Inspected all parts and repaired or replaced as required.	______	______
5.	Reassembled according to specifications.	______	______
6.	Replaced oil and checked for leaks.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature Date

MAINTAINING AND SERVICING FINAL DRIVES

DUTY: MAINTAINING AND SERVICING FINAL DRIVE

PERFORMANCE OBJECTIVE V-TECS 173

TASK: Adjust end play in final drive.

STANDARD OF PERFORMANCE OF TASK:
Adjust the end play in the final drive on the designated tractor. All parts will be disassembled and reassembled according to manufacturer's instructions, and the end play will be within the limits specified in the service manual.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Using a designated tractor and the manufacturer's service manual, a dial indicator, shims and the necessary tools, adjust the end play in the final drive.

ENABLING OBJECTIVE(S):

1. Know shop safety.
2. Use hand tools.
3. Ability to read.

RESOURCES:

1. Operator's manual for designated tractor.
2. Operator's manual for dial indicator.
3. Service manual.

TEACHING ACTIVITIES:

1. Discuss shop safety.
2. Discuss final drives, their function and purpose.
3. Discuss importance of proper end play in final drives.
4. Discuss dial indicators.
5. Discuss shimsand their use.
6. Demonstrate the use of dial indicators.
7. Have students demonstrate the use of dial indicators.
8. Demonstrate the procedure for the proper adjustment of end play in the final drive.
9. Have students adjust end play in final drive on designated tractor.

CRITERION REFERENCED MEASURE:

Practical Application:
Measure and adjust end play in final drive using a dial indicator.

Method of Evaluating Practical Application:
Using the checklist for Performance Objective 173, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 173 EVALUATION

PERFORMANCE TEST FOR ADJUSTING END PLAY IN FINAL DRIVE

Student's Name **Date**

DIRECTIONS TO STUDENT: Adjust the end play in the final drive on the designated tractor. All parts will be disassembled and reassembled according to manufacturer's instructions, and the end play will be within the limits specified in the service manual.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Removed parts properly.	______	______
2. Mounted dial indicator properly and checked end play properly.	______	______
3. Adjusted end play with shims.	______	______
4. Reassembled properly.	______	______

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING FINAL DRIVE

PERFORMANCE OBJECTIVE V-TECS 174

TASK: Preload and install bearings in final drive.

STANDARD OF PERFORMANCE OF TASK:
Preload and install bearings in the final drive on the designated tractor. The disassembly and assembly will follow manufacturer's directions and specifications. All parts will be clean and undamaged.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist

CONDITIONS FOR PERFORMANCE OF TASK:
Using the designated tractor and the manufacturer's service manual, correct tools and equipment, solvent, grease and any needed replacement parts, preload and install bearings in the final drive.

ENABLING OBJECTIVE(S):

1. Know shop safety.
2. Use hand tools.
3. Ability to read.

RESOURCES:

1. Operator's manual for designated tractor.
2. Service manual.

TEACHING ACTIVITIES:

1. Discuss shop safety.
2. Discuss bearing lubrication and its importance.
3. Discuss jacks and their proper and safe use.
4. Discuss the two types of wheel bearing assemblies.
5. Demonstrate proper lubrication of bearings.
6. Demonstrate proper jack use.
7. Demonstrate how to preload and install bearings in final drive.

CRITERION REFERENCED MEASURE:

Practical Application:
Preload and install bearings in final drive.

Method of Evaluating Practical Application:
Using the checklist for Performance Objective 174, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 174 EVALUATION

PERFORMANCE TEST FOR PRELOADING AND INSTALLING BEARINGS IN FINAL DRIVE

Student's Name **Date**

DIRECTIONS TO STUDENT: Preload and install bearings in the final drive on the designated tractor. The disassembly and assembly will follow manufacturer's directions and specifications. All parts will be clean and undamaged.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

	ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1.	Jacked up and properly prepared tractor.		
2.	Removed hubcap and pulled wheel.		
3.	Cleaned up and removed solvent from necessary parts.		
4.	Examined parts for wear and damage.		
5.	Repacked and reassembled bearings.		
6.	Adjusted all parts to manufacturer's specifications.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING FINAL DRIVE

PERFORMANCE OBJECTIVE V-TECS 175

TASK: Service final drives.

STANDARD OF PERFORMANCE OF TASK:
Service the final drive on the designated tractor. All parts will be clean and lubricated. All parts will be torqued according to manufacturer's specifications, and there will be no damage to any parts. Disassembly and reassembly will follow manufacturer's recommendations.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist

CONDITIONS FOR PERFORMANCE OF TASK:
Using the designated tractor and service manual, proper tools, cleaning solution, lubrications, and replacement parts, service three types of final drives.

ENABLING OBJECTIVE(S):

1. Know shop safety.
2. Ability to read.
3. Use of hand tools.

RESOURCES:

1. Operator's manual for designated tractor.
2. Operator's manual for torque wrench.
3. Service manual.

TEACHING ACTIVITIES:

1. Discuss shop safety.
2. Discuss torque wrenches.
3. Demonstrate the use of torque wrenches.
4. Discuss three types of final drives and their function and purpose.
5. Discuss lubricants.
6. Demonstrate the procedures for servicing the three types of final drives.

CRITERION REFERENCED MEASURE:

Practical Application:
Service the final drives.

Method of Evaluating Practical Application:
Using the checklist for Performance Objective 175, all items must be rated satisfactory.

PERFORMANCE OBJECTIVE V-TECS 175 (Continued)

PERFORMANCE GUIDE:

NOTE: There are three major types of final drive systems -- pinion and planetary. Check manufacturer's service manual to determine the type of final drive for the tractor to be serviced.

1. Service pinion drive system. NOTE: There are two types of pinion and gear reductions -- (a) a pinion drive located in the differential case, and (b) a pinion drive located on the outer ends of final drives.
    a. Pinion drive inside differential case:
        -- Following instructions in the manufacturer's service manual, disassemble all parts necessary to reach pinion drive.
        -- Remove pinion gears, clean thoroughly, checking for wear or damage. Repair or replace parts where necessary.
        -- Reassemble pinion gears and torque to manufacturer's specifications.
        -- Reassemble gears in differential case to manufacturer's instructions and specifications.
    b. Pinion drive on outer ends of final drives:
        -- Following instructions in the service manual, remove all parts necessary to reach the case or housing for pinion gears.
        -- Detach gear housing from the differential and wheels.
        -- Remove pinion gear and spur gear from housing, discarding old oil. Clean, inspect for damage, and repair or replace parts if necessary.
        -- Reassemble gears according to manufacturer's instructions and specifications and replace oil.
        -- Reassemble gear housing and all other parts removed following directions in the service manual.
2. Service planetary drive system. (See Performance Objective 176)

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 175 EVALUATION

PERFORMANCE TEST FOR SERVICING FINAL DRIVES

Student's Name **Date**

DIRECTIONS TO STUDENT: Service the final drive on the designated tractor. All parts will be torqued according to manufacturer's specifications, and there will be no damage to parts.

DIRECTIONS TO EVALUATOR: Provide needed supplies and equipment. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Pinion type -- Followed instructions for disassembly and cleaning.		
2. Checked for wear.		
3. Reassembled and torqued properly.		
4. Pinion drive on outer ends -- Followed instructions to remove proper parts.		
5. Removed, cleaned, and inspected parts.		
6. Put in new oil and reassembled to manufacturer's specifications.		
7. Planetary drive -- Followed instructions for disassembly and cleaning.		
8. Checked for wear.		
9. Reassembled and torqued properly.		
10. Lubricated and reassembled to manufacturer's specifications.		

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

DUTY: MAINTAINING AND SERVICING FINAL DRIVE

PERFORMANCE OBJECTIVE V-TECS 176

TASK: Service inboard and outboard mounted planetary drives.

STANDARD OF PERFORMANCE OF TASK:
Service the inboard and outboard mounted planetary drives on the designated tractor(s). All parts will be thoroughly cleaned. Disassembly and reassembly will be in order of manufacturer's instructions. There will be no damage to any part.

SOURCE OF STANDARD:
Kentucky Writing Team -- Content Specialist.

CONDITIONS FOR PERFORMANCE OF TASK:
Given the manufacturer's serice manual and the needed tools, and replace parts, service inboard and outboard mounted planetary drives.

ENABLING OBJECTIVE(S):

1. Know shop safety.
2. Use hand tools.
3. Ability to read.

RESOURCES:

1. Operator's manual for designated tractor.
2. Service manual.

TEACHING ACTIVITIES:

1. Discuss shop safety.
2. Discuss planetary drives and their function and purpose.
3. Demonstrate servicing planetary drives.
4. Have students list the steps followed when servicing planetary drives.
5. Have students service planetary drives.

CRITERION REFERENCED MEASURE:

Practical Application:
Service inboard and outboard mounted planetary drives.

Method of Evaluating Practical Application:
Using the checklist for Performance Objective 176, all items must be rated satisfactory.

CHECKLIST FOR PERFORMANCE OBJECTIVE V-TECS 176 EVALUATION

PERFORMANCE TEST FOR SERVICING INBOARD AND OUTBOARD MOUNTED PLANETARY DRIVES

Student's Name **Date**

DIRECTIONS TO STUDENT: Service the inboard and outboard mounted planetary drives on the designated tractors. All parts will be thoroughly cleaned. Disassembly and reassembly will be in order of manufacturer's instructions. There will be no damage to any part.

DIRECTIONS TO EVALUATOR: Provide needed equipment and supplies. Observe student. All items must be rated satisfactory.

ITEMS TO BE EVALUATED	Satisfactory	Unsatisfactory
1. Referred to manufacturer's guide for instructions.	____	____
2. Disassembled rear axle shaft.	____	____
3. Disassembled the planetary drive.	____	____
4. Cleaned and inspected.	____	____
5. Reassembled the planetary drive and rear axle shaft according to manufacturer's specifications.	____	____

APPROVED: Yes _____ No _____

Evaluator's Signature **Date**

APPENDICES

APPENDIX A

DEFINITION OF TERMS

The following terms are supplied to establish operational definitions as they apply to this study.

CAREER LADDER: A vertical arrangement of jobs within an occupational area to indicate skill distinction and progression.

CATALOGS: A comprehensive collection of performance objectives, performance guides, criterion-referenced measures, and related data organized by a job structure or career ladder within a domain of interest.

CONSORTIUM: A group of state agencies, institutions, or other entities which has been legally constituted through letters of commitment, agreements, or by assignment of higher authorities to work together toward the solution of problems in education. A membership from autonomous agencies and institutions which cuts across state boundaries as it attempts to solve problems or meet goals.

D.O.T. CODE: A nine-digit number used to identify a specific job within a given domain.

INSTRUCTIONAL SYSTEM DEVELOPMENT (ISD): A deliberate, orderly process for planning and developing instructional programs which insures that personnel are taught the knowledge, skills, and attitudes essential for successful job performance. Depends on a description and analysis of the tasks necessary for performing the job, objectives, evaluation procedures to determine whether or not the objectives have been reached, and methods for revising the process based on empirical data.

OCCUPATIONAL INVENTORY (TASK INVENTORY BOOKLET): A survey instrument containing tasks performed by job incumbents within D.O.T.'s complete with background information and a list of tools and equipment.

PERFORMANCE-BASED INSTRUCTION: Instruction which, when properly designed and applied, results in the learner's demonstration of certain abilities. The desired abilities are selected before the instruction is designed and are clearly defined as observable performance objectives. In V-TECS catalogs, the abilities are primarily psychomotor. This type of instruction is also referred to as competency-based instruction.

PERFORMANCE GUIDE (PG): A series of steps, arranged in a sequence ordinarily followed, which when completed may result in the performance of a task. Also, called "teaching steps."

PROJECT: An occupational domain area selected by a V-TECS member state for catalog; development based upon the U.S. Department of Labor's Dictionary of Occupational Titles (D.O.T.).

STATE-OF-THE-ART (SOA STUDY): Research conducted to determine the current status of performance-based instructional materials and practices in the domain area under study and to obtain other information that might be useful in catalog development.

TASK: A unit of work activity which constitutes logical and necessary steps in the performance of a duty. A task has a definite beginning and ending point in its accomplishments and generally consists of two or more definite steps.

TASK ANALYSIS: A characteristic of a task statement which makes its accomplishments crucial to the acceptable performance of a worker or student. A method of analysis which identifies the critical tasks and aids in determining the consequence of poor performance or lack of performance by the worker or student.

WRITING TEAM: A team of people representing instructors within subject matter expertise, persons having knowledge and experience in developing criterion- referenced measures, and local or state supervisors of incumbent workers whose function is to analyze occupational data and develop performance objectives and criterion-referenced measures for specific D.O.T. areas.

APPENDIX B

DUTIES AND TASKS

	Duty and Task	Performance Objective/ Page Number
I.	PERFORMING GENERAL SKILLS	
	Adjust wheel bearings	1/5
	Adjust wheel bearings	2/7
	Check tires for pressure, wear and defects	3/9
	Check torque connecter with test equipment	4/*
	Inspect new tractor parts for shipping damage	5/11
	Clean tractor with steam cleaner (prepare steam cleaner for use)	6/13
	Clean tractor with steam cleaner (shut off steam cleaner)	7/15
	Clean tractor with steam cleaner	8/17
	Paint tractors	9/19
	Paint tractors	10/21
	Repair brake assemblies	11/23
	Service air cleaner (oil bath)	12/25
	Service drive shafts	13/27
	Service an engine governor	14/29
	Service hydraulic governor (diesel)	15/31
	Service power take-off drive	16/33
	Service special drives (belt, chain, gear and variable speed)	17/35
	Service a torque converter	18/37
	Service universal joints	19/39
	Test engine compression	20/41
	Use the dynamometer	21/43
II.	MAINTAINING AND SERVICING STORAGE BATTERY	
	Activate dry-charged battery	22/46
	Charge a wet cell battery	23/48
	Clean battery terminals, cables and battery box	24/50
	Measure the specific gravity of a battery using a hydrometer	25/52
	Measure the voltage of a battery using the voltmeter	26/55
	Run a load test on a battery	27/58
	Run a load test on a battery	28/61
	Tighten battery cables and battery hold down	29/64
	Treat battery terminals to prevent corrosion	30/66

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Duty and Task	Performance Objective/ Page Number
III. MAINTAINING AND SERVICING THE IGNITION CIRCUIT	
Measure resistance using ohmmeter	31/70
Replace distributor points and condenser	32/72
Replace ignition distributor	33/74
Replace ignition wire	34/76
Replace ignition wire	35/78
Service spark plugs	36/80
Set breaker point dwell using a dwell meter	37/82
Set ignition timing using a timing light	38/84
Test distributor advance mechanism	39/86
Test and replace ignition coil	40/88
Test ignition distributor	41/90
IV. MAINTAINING AND SERVICING THE COOLING SYSTEM	
Flush and clean radiator	42/93
Replace cooling system thermostat	43/95
Replace radiator hose	44/97
Replace water pump	45/99
Service fanbelts	46/101
Test cooling system for leaks	47/103
Test radiator coolant	48/105
Test radiator pressure caps	49/107
Test thermostat	50/109
V. MAINTAINING AND SERVICING THE CHARGING CIRCUIT	
Adjust voltage regulator	51/112
Adjust voltage regulator	52/114
Check armature and fields	53/116
Polarize a tractor generator	54/118
Test a tractor generator on a bench using the test for the common A circuit generator	55/119
Replace amperage gauge	56/121
Replace bearings (alternator or generator)	57/123
Replace diodes	58/124
Replace generator brushes	59/126
Replace heat sink	60/128
Service the alternator regulator	61/130
Test alternator diodes	62/132
Test charging circuit using a voltmeter, ammeter and/or carbon pile	63/133
Turn armature	64/135

Duty and Task	Performance Objective/ Page Number
VI. MAINTAINING AND SERVICING THE STARTING CIRCUIT	
Check armature and fields	65/138
Check ignition switch	66/140
Check safety switches	67/142
Check solenoid	68/144
Replace bearings and bushings	69/146
Replace ring gear	70/148
Replace starter brushes	71/150
Replace starter drive	72/152
Replace starter motor solenoid	73/154
Replace starter motors	74/156
Turn armature	75/158
VII. MAINTAINING AND SERVICING GASOLINE FUEL SYSTEM	
Adjust carburetor float	76/161
Adjust carburetor idle air/fuel mixture	77/163
Adjust engine idle speed	78/165
Clean carburetor	79/167
Clean settling bulb (sediment bowl)	80/169
Install carburetor repair kit	81/171
Replace fuel pump	82/173
Service a fuel pump (diaphragm type)	83/175
Service fuel tanks and fuel lines	84/177
VIII. MAINTAINING AND SERVICING DIESEL FUEL SYSTEM	
Bleed a diesel fuel system	85/180
Service diesel fuel filters	86/182
Service a diesel fuel injector	87/184
Service the diesel injector pump	88/187
Service a diesel-transfer pump	89/190
Service turbochargers	90/193
Time fuel injector pump to engine	91/195
IX. MAINTAINING AND SERVICING BASIC ENGINE	
Adjust valve clearance	92/198
Check cylinder head and block for warpage	93/201
Check cylinder block, oil passages and piston	94/203
Deglaze cylinder	95/206
Grind valves	96/208
Install connections rod caps	97/211
Install a crankshaft	98/214
Install cylinder heads	99/216
Install front oil seals	100/218
Install main bearings and caps	101/220
Install piston assembly	102/223
Install rear main oil seals	103/225

	Duty and Task	Performance Objective/ Page Number
	Install rod bearings	104/227
	Install a timing chain or gears	105/229
	Measure bearing clearance	106/231
	Measure camshaft for wear	107/233
	Measure and record the crankshaft main and rod journals	108/234
	Measure cylinder tapes	109/236
	Measure piston ring end gap	110/238
	Measure piston ring land clearance	111/240
	Measure valve stem guide clearance	112/242
	Reface valve seats	113/243
	Remove carbon from ring grooves	114/245
	Remove cylinder ridge	115/246
	Remove piston assembly	116/248
	Remove camshaft bearings	117/249
	Replace dry sleeves	118/251
	Replace oil pan gasket assembly	119/253
	Replace piston rings	120/255
	Replace rear engine oil seal	121/257
	Replace rocker arms	122/259
	Replace valve guides	123/261
	Replace wet sleeves	124/263
	Service intake manifold	125/266
	Test valve springs	126/268
	Torque main bearings	127/270
X.	MAINTAINING AND SERVICING LUBRICATION SYSTEM	
	Change oil filter	128/272
	Change tractor oils (engine and/or transmission)	129/274
	Check engine crankcase oil level	130/276
	Check transmission and/or differential lubricant levels	131/278
	Check transmission and/or differential lubricant levels (continued)	132/280
	Drain and refill differentials	133/282
	Pack wheel bearings	134/284
	Service oil coolers	135/286
	Service oil pumps	136/288
XI.	MAINTAINING AND SERVICING CLUTCHES	
	Adjust clutch free play	137/291
	Service a dry clutch	138/293
	Service an expanding shoe clutch	139/295
	Service a magnetic clutch	140/297
	Service an overrunning clutch	141/299
	Service a wet clutch	142/301

Duty and Task	Performance Objective Page Number
XII. MAINTAINING AND SERVICING HYDRAULICS	
Change hydraulic filters	143/304
Clean and flush the hydraulic system	144/306
Drain and refill hydraulic system	145/308
Maintain hydraulic cylinders	146/310
Operate and analyze with a hydraulic tester	147/312
Repair hydraulic assist transmissions	148/315
Repair hydraulic cylinders	149/317
Repair hydraulic motors	150/319
Replace hydraulic fittings	151/321
Service and adjust hydraulic assist transmissions	152/323
Service hydraulic pumps	153/325
Service hydraulic pumps	154/327
Service hydraulic motors	155/329
Service hydrostatic drive	156/331
Service and repair hydraulic pumps	157/333
Service and repair hydraulic valves	158/335
Service and repair internal hydraulic pump	159/337
Trouble shoot a hydraulic-assist transmission	160/339
XIII. MAINTAINING AND SERVICING POWERTRAIN	
Measure backlash and clearance in gear train	161/342
Measure and play movement in gear shaft	162/344
Preload bearings in gear train	163/346
Service constant mesh transmission (Ford)	164/349
Service power-shift transmission	165/352
Service sliding-gear transmission	166/354
XIV. MAINTAINING AND SERVICING DIFFERENTIALS	
Correct adjustment of ring gear and pinion	167/357
Preload bearings	168/359
Repair differentials	169/361
Replace brake and axle seals and gaskets	170/363
Service differential locks (mechanical, hydraulics)	171/365
XV. MAINTAINING AND SERVICING FINAL DRIVES	
Adjust chain drive in final drive	172/*
Adjust end play in final drive	173/368
Preload and install bearings in final drive	174/370
Service final drives	175/372
Service inboard and outboard mounted planetary drives	176/375

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APPENDIX C

EQUIPMENT AND TOOLS

Percentage Rating of Those Performing

Equipment Description	Number of Members Using	Percentage of Members Using
Battery Jumper Cables	161	97.58
Hacksaw	161	97.58
Extension Cord	160	96.97
Hammers, Ball Pein	160	96.97
Jack, Hydraulic	160	96.97
Wrench Set, Box End	160	96.97
Wrench set, Combination	160	96.97
Battery Charger	159	96.36
Creeper	159	96.36
Drill, Portable Electric (1/2" and 1/4")	159	96.36
Grinder, Bench	159	96.36
Hammer, Sledge	159	96.36
Socket Set, 1/2" Drive	159	96.36
Wrenches, Allen Set/Miscellaneous	159	96.36
Files, Assorted	158	95.76
Screwdrivers, Miscellaneous	158	95.76
Socket Set, 3/8" Drive	158	95.76
Chisels, Assorted	157	95.15
Pullers, Wheel	156	94.55
Compressor, Air	155	93.94
Gauge, Feeler	155	93.94
Socket Set, 1/4" Drive	155	93.94
Wrench Set, Open End	155	93.94
Wrenches, Adjustable	155	93.94
Face, Shield	154	93.33
Pliers, Miscellaneous	154	93.33
Rule	154	93.33
Wire Brush	154	93.33
Gauge, Spark Plug	153	92.73
Battery Terminal Cleaner	152	92.12
Hoist, Chain	152	92.12
Punches, Assorted	152	92.12
Torch, Cutting	152	92.12
Wrench, Torque	152	92.12
Socket Set, 3/4" Drive	151	91.52
Vise, Machinist's 4" Jaw	151	91.52
Wrench Kit, Impact	151	91.52
Anvil	150	90.91
Fire Extinguisher	149	90.30
Clamps, Assorted	148	89.70

Equipment Description	Number of Members Using	Percentage of Members Using
Trouble Lights	148	89.70
Cutter, Bolt	147	89.09
Stands, Jack	147	89.09
Wrench Set, Ignition	146	88.48
Battery Cell Tester	145	87.88
First Aid Kit	144	87.27
Hone, Cylinder	144	87.27
Welder, Arc	144	87.27
Instrument, Timing Light	143	86.67
Sander, Portable Disc	141	85.45
Battery Carrying Strap	139	84.24
Compressor, Valve Spring	139	84.24
Bars, Wrecking and Utility	138	83.64
Cleaner, Piston Groove	138	83.64
Compressor, Piston Ring	138	83.64
Grinder, Portable Electric	138	83.64
Cleaner, Steam	137	83.03
Soldering Iron	136	82.42
Tap and Die Set, 1/4" to 3/4"	136	82.42
Welder, Oxy-Acetylene	136	82.42
Tin Snips, 12"	135	81.82
Tubing Tools, Cutter, Flarer, Etc.	135	81.82
Hammers, Soft Faced	132	80.00
Instrument, Compression Gauge	132	80.00
Screw Extractor Set, 1/4" -- 7/8"	132	80.00
Bushing Driver Set	129	78.18
Vise, Machinist's 5" Jaw	128	77.58
Reamer, Ridge	126	76.36
Valve Spring Compressor	126	76.36
Battery Hydrometer	125	76.76
Drill Press, Floor	124	75.15
Parts, Washer	124	75.15
Battery Bulb Filler	121	73.33
Grinder, Valve	121	73.33
Paint Spray Gun	121	73.33
Tire Irons	121	73.33
Grinder, Valve Seat Kit	120	72.73
Mallet, Rubber	117	70.91
Twist Drill Set	117	70.91
Dial Indicator Test Set	115	69.70
Dynamometer	114	69.09
Grinder, Valve Face	113	68.48
Grinding Wheel Dresser	112	67.88
Instrument, Diesel Nozzle/Injector Tester	111	67.27
Paint Spray Filter and Regulator	111	67.27

Equipment Description	Number of Members Using	Percentage of Members Using
Hoist, Portable	109	66.06
Gauge, Fuel Pressure	107	64.85
Gauge, Vacuum	101	61.21
Indicator, Dial	101	61.21
Instrument, Amps Volts Regulator Tester	97	58.79
Hydrometer	94	56.97
Instrument, Dwell-Tachometer	93	56.36
Seat and Tool Tray	93	56.36
Battery Terminal Lifter	92	55.76
Press, Arbor	92	55.76
Speed Indicator	92	55.76
Stand, Engine	89	53.94
Micrometer Set	88	53.33
Instrument, Alternator-Regulator Tester	84	50.91
Jack, Tricycle Stand	84	50.91
Tire Changer	84	50.91
Growler	68	41.21
Instrument, Spark Plug Cleaner-Tester	62	37.58
Aligner, Connecting Rod	54	32.73
Lathe, Armature	53	32.12
Drill Sharpening Attachment	49	29.70
Drill Press, Hydraulic	40	24.24
Instrument, Diesel Pump Calibrating Stand	33	20.00
Instrument, Exhaust Analyzer	23	13.94
	Additional tools added by the responding incumbent workers.	
Hydraulic Pressure Gauges	8	4.85
Bushing Hone (Master Cylinder, Wheel Cyl.)	5	3.03
High Pressure Washer	5	3.03
Special John Deere Tools	5	3.03
Pipe Wrenches	3	1.82
Hydraulic Test Equipment, Gauges, Flo-Rate	3	1.82
Hydraulic Pump Rebuilding Tools	3	1.82
Boring Bar	2	1.21
Sleeve Puller	2	1.21
Snap Ring Pliers	2	1.21
Massey Ferguson Special Tools	2	1.21
Oil Sucking Gun	2	1.21
Diesel Engine Compressor Tester	2	1.21
Clutch Lining Tools	2	1.21
Riveting Machine	2	1.21
Magnets	2	1.21
Square and Level	1	0.61

Equipment Description	Number of Members Using	Percentage of Members Using
Plastic Gauge for Checking Bearing Clear	1	0.61
Coil and Condenser Tester	1	0.61
Brake Bleeder	1	0.61
Bearing Load Tester, Pounds Pull Gauge	1	0.61
Valve Seat Cutter	1	0.61
Hot Tank Cleaner	1	0.61
Parts Cleaner	1	0.61
Scales	1	0.61
Weight	1	0.61
Reamers (Specialized)	1	0.61
Pilot Tools	1	0.61
Pipe Dies	1	0.61
Hard Surfacing, Carbon Arc and Acetylene	1	0.61
Drill Press, Floor Model	1	0.61
Clutch Adjusting Tools	1	0.61
Hammer for Breaking Tires	1	0.61
Band Saw (Metal)	1	0.61
Stacon Pliers, Connection	1	0.61
Charts on MM to Inches	1	0.61
Lathe, Table	1	0.61
Electrical Short Tester	1	0.61
Test Light 12V to 6V	1	0.61
Gasket Hole Cutter	1	0.61
Slide Hammer Puller	1	0.61
Pump for Repairing Tires	1	0.61
Tractor Lift	1	0.61
Brake Tools	1	0.61
Adjustable Stands	1	0.61
Fluid Pump, Tire	1	0.61
Milling Machine	1	0.61
Woodruff Key Cutter	1	0.61
Cylinder Head Grinder	1	0.61
Saw Chain Sharpener, Grinder	1	0.61
Nut Crackers	1	0.61
Oil and Grease Seal Drivers	1	0.61
Air Chisel	1	0.61

APPENDIX D

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1. Kentucky Writing Team -- Content Specialist
2. Kentucky Writing Team -- Supervisor
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5. **Fundamentals of Operation -- Engines,** Deere and Company, Moline, ILL., 1972.
6. **Motors Auto Repair Manual,** 31st Edition, Motor, 250 W. 55th Street, New York, 1968.
7. **Preventive Maintenance,** Deere and Company, Moline, ILL., 1973.
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9. **Tractor Maintenance,** Southern Association for Agricultural Engineering and Vocational Agriculture.
10. **Fundamentals of Service -- Electrical Systems,** Deere and Company, Moline, ILL., 1972.
11. **Fundamentals of Service -- Engines,** Deere and Company, Moline, ILL., 1972.
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